OhioEPA Ohio Environmental Protection Agency

Maumee River REMEDIAL ACTION PLAN

Stage I Investigation Report

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Maumee River Remedial Action Plan Advisory Committee

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LOWER MAUMEE RIVER
REMEDIAL ACTION PLAN
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INTRODUCTION

The Lower Maumee River area around Toledo, Ohio has a wide variety of pollution problems. Although there have been dramatic water quality improvements over the past decade, serious problems still exist that affect not only water quality itself, but also the area's fish, wildlife, wetlands and public uses. These problems are being caused by excess sediments, nutrients and toxics entering the system. The result has been the need to issue fish consumption advisories, curtailment of body contact water use, and increased stress for all species, especially those endangered. Problems in the Lower Maumee River area contribute to problems in Lake Erie and the Great Lakes, affecting both the United States and Canada.

A binational organization, the International Joint Commission (IJC), was established by the Boundary Waters Treaty in 1909 to advise the Governments of the United States and Canada on preventing or resolving problems along their common border. This includes addressing the pollution problems of the Great Lakes. To provide a coordinated cleanup effort on phosphorus and the resultant eutrophication of the Great Lakes, the Great Lakes Water Quality Agreement was signed by the two governments in 1972. This Agreement was later revised in 1978 in order to focus on toxics and on an ecosystem approach, as well as to further define phosphorus control.

In 1985, based on the recommendations of the states and provinces, the Commission's Water Quality Board identified forty-two Areas of Concern (AOC) in the Great Lakes basin. An AOC is an area where water uses are impaired or where objectives of the Great Lakes Water Quality Agreement or local environmental standards are not being achieved. Four AOCs are located in Ohio: Ashtabula, Cuyahoga, Black and Maumee rivers. Heavy metals and organic chemical sediment contamination has led to the Lower Maumee River being classified as an Area of Concern (Great Lakes Water Quality Board, 1985). Also, the Maumee River contributes the largest tributary load of suspended sediments and phosphorus to the Maumee Bay and the Western Basin of Lake Erie.

The 1987 Great Lakes Water Quality Agreement revisions were signed in Toledo at the 1987 Biennial meeting of the IJC. The revised agreement re-emphasized the ecosystem approach and required the development of specific programs to achieve the goals previously listed in the 1978 agreeement. It specifically presented guidelines for preparation of Remedial Action Plans (RAPs) to address the problems in the AOCs and restore beneficial uses. The RAP is an agreement among responsible federal, state and local governments with the support of area citizens to restore the water quality and beneficial uses in each AOC (Great Lakes Water Quality Agreement, 1978).

The Maumee Basin AOC addressed in this document, has been identified as the area extending from the Bowling Green water intake along the Maumee River at River Mile (RM) 22.8 downstream to Maumee Bay, including the entire bay and nearshore waters from the Michigan state line to Crane Creek State Park in Ohio. The area includes direct drainage into these waters that are within Lucas, Ottawa and Wood Counties. This includes Swan Creek, Ottawa River (Ten Mile Creek), Duck Creek, Otter Creek, Cedar Creek, Grassy Creek, and Crane Creek. Figure 1 is a map of the area.

As required by Annex II of the 1987 agreement, an Investigation Report of the Remedial Action Plan for the Lower Maumee River Basin is the supporting documentation that identifies the environmental problems. It also identifies the known sources of the pollutants and the water and related uses that are impaired as a result of the problems. This document is known as Stage I, the first of three stages in the development of the complete RAP.

The Ohio EPA is the lead agency for the RAP effort in Ohio. The Toledo Metropolitan Area Council of Governments (TMACOG), prepared the Investigation Report for the Lower Maumee River Area of Concern which addresses both nonpoint and point source pollution. From this Investigation Report, the Ohio EPA drafted Stage I of the RAP.

Stages II and III will follow this document. Stage II will evaluate existing remedial actions to correct problems in the AOC, pose alternative measures, select actions and identify the entities or individuals responsible for implementing these actions. The effectiveness of the implementation of these actions, the surveillance and monitoring to affirm their effectiveness, and the confirmation of the the restoration of the beneficial uses will be discussed in the Stage III report.

This Stage I report is organized to first discuss the environmental setting, and the existing beneficial water uses including current water biological and sediment quality data. It also describes intensive or short-term monitoring surveys which have occurred in the RAP area along with an analysis of the water biolgical and sediment quality data.

Secondly, this report describes water pollution sources within the RAP area and the impacts of each of these sources on the beneficial uses. These include phosphorus sources, NPDES permitted wastewater dischargers for the industrial and municipal sectors, package sewage treatment plants, agricultural runoff, open water disposal of dredged materials, urban stormwater, home sewage disposal, active and closed landfills/dumpsites and pits, ponds and lagoons, and atmospheric deposition related to acid rain. Maps in each source section indicate the level of degradation in the individual, smaller watersheds within the AOC.

Key tables and maps are included with this document to assist the reader in reviewing the information. A glossary is included which defines various terms and agencies found within this document. The data appendices have been printed as a separate document and are available upon request.

More than a hundred persons have had input into the preparation of this Stage I document. The 74 member Remedial Action Plan Advisory Committee subdivided itself into seven major subcommittees, bringing other persons into the process. These subcommittees included: Water Quality and Water Uses, Dredge Disposal, Agricultural Runoff, Home Sewage Disposal, Landfills and Dumps, Public and Industrial Dischargers, and Fish and Wildlife.

Efforts to address phosphorus pollution and the resultant water quality impairment of Lake Erie include Ohio EPA's work with a task force of interested individuals, farmers and representatives of many organizations to produce the State of Ohio Lake Erie Phosphorus Reduction Strategy (Ohio EPA, 1989a). In March 1988, Ohio adopted a phosphorus limitation for detergent loads in the 35 counties of northern Ohio draining into Lake Erie. In the mid-seventies, the U.S. Army Corps of Engineers conducted the Lake Erie Wastewater Management Study and the International Joint Commission undertook a study of land use activities in the Great Lakes. Additionally, the Soil Conservation Service yearly undertakes the Conservation Tillage Tracking Survey to estimate Lake Erie acreage under conservation tillage. This survey is an important component of the Lake Erie Phosphorus Reduction Strategy. Because there has been such extensive research and field investigations in the Maumee Basin, information for the AOC and the Maumee River basin is very complete in Ohio.

GENERAL DESCRIPTION OF THE PROBLEM

The Maumee River contributes the largest tributary load of suspended sediments and phosphorus to Lake Erie. Phosphorus is considered the critical nutrient contributing to the cultural eutrophication of Lake Erie. The major source is agricultural runoff upstream of the Lower Maumee River Area of Concern's boundaries.

The most prevalent nonpoint source pollutant by volume is sediment, which is a result of soil erosion. The problem stems from the predominance of agricultural land use, the extensive use of row crop agricultural systems, and the soil characteristics of the Maumee River basin. In spite of a low per acre erosion rate, the 1.2 million metric tons eroded annually cause a significant water quality problem.

Sediment pollutant levels in the Maumee River are classified as either moderately or heavily polluted for heavy metals from a point at Rossford (RM 9.4) to the Maumee Bay, with the highest concentrations of most metals in the sediment found at or slightly above the mouth near Toledo's Wastewater Treatment Plant to River Mile 2 (vicinity of Norfolk Southern Railroad Bridge). Metals of concern include: chromium, copper, lead, nickel, zinc, manganese and arsenic.

Nitrate concentrations have exceeded water quality standards on the Maumee River, causing both Waterville and Bowling Green to have drinking water advisories issued during late winter, spring and early summer. Nitrogen is an essential plant nutrient that is applied to cropland as a fertilizer. Nitrates are soluble and are carried to waterways with the runoff water, rather than with the sediment. Field tile effluent often carries nitrates to waterways.

The aquatic life habitat use designation listed in the Ohio Water Quality Standards for the Maumee River is Warmwater Habitat. The habitat conditions of this designation are not being attained in the Maumee River from Rossford at RM 9.4 to Maumee Bay. Arsenic seems to be the most significant industrial problem at RM 7.4. High levels of arsenic have been detected at the South Avenue Dump, and although this site is downstream from RM 7.4 it is still within the seiche effect area. The combined sewer overflows begin at RM 4.7 (area of Portside) and become a real problem after the confluence with Swan Creek. Below the Martin Luther King Bridge (also known as the Cherry Street Bridge) at RM 4.7, the dissolved oxygen is very low. Ammonia and nitrites are elevated starting at the Norfolk Southern Railroad Bridge (approximately RM 2.1). Zinc is elevated above the mouth.

Documented investigation of fish species for the Maumee River show a 50% decline since 1981. Fish community composite and quality values drop 2 points from the Grand Rapids dam to the mouth. It is thought that the upstream movement of the Toledo WWTP plume and the numerous combined sewer overflow discharges are the cause of the low community values. The lowest fish community values occur in the area between the Toledo WWTP into the Maumee Bay area of the Toledo Edison intake channel. Loss of habitat for these communities is also a problem.

Organic pollutants of concern include polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and phthalates. These toxic chemicals, as well as the heavy metals, are known to biomagnify, bioaccumulate, or are suspected of causing cancer and are acutely toxic to aquatic organisms. PAHs and phthalates have been found at detectable levels in the Maumee shipping channel. Studies of Toledo Harbor sediments have not shown sediment bound pesticides at levels high enough to arouse concern. Dioxins and furans, however, have not been studied. The PAH concentrations are at the lower end of the range of values found at other sites in Ohio displaying cancer epizootics and posing a potential problem.

Bottom dwelling organisms avoid or cannot exist in areas which are highly contaminated with toxic compounds. They may, however, survive in areas where low levels of toxicants are found. This means that they are exposed to these contaminants constantly throughout their life spans. After accumulating toxicants, these organisms, if eaten, are the starting point for toxicants to move up the food chain to fish, then onto fish-eating birds and/or humans where they can accumulate.

Impacting water quality on the Ottawa River are the abandoned dumps sited in the floodplains which leak solvents, conventional pollutants and organic priority pollutants. The Dura Dump leachate, for example, contains high BOD, COD and organics, including PCBs. The City of Toledo has posted the area advising persons to avoid contact with the water, sediments and fish.

The degradation of Otter Creek is directly related to arsenic leaking from settling ponds created over thirty years ago. This creek has been a known "industrial sewer" for over twenty years, with oil soaked banks, and nickel and cyanide being detected in its waters. Swan Creek has poor water quality from its mouth to four miles upstream. Heavy metals, with the greatest impact between Hawley Street and Collingwood Boulevard, have helped to cause a 50 percent decline of fish species since 1981.

The AOC can be viewed as an area of adverse water quality impacts. In some cases, however, the sources of these impacts are outside of the Lower Maumee River AOC's boundaries. This is particularly true of the agricultural sources. Therefore, implementation of the RAP must not be limited to the AOC's boundaries if significant water quality improvements are to be achieved. The focus of this document is on the Lower Maumee River Basin. Since the pollution sources causing the water quality problems in Maumee Bay begin far upstream from the harbor mouth, remedial actions designed to help control nonpoint source pollution must be implemented upstream of the Maumee Bay.

A complete summary of the environmental problems for the Lower Maumee River, as related to the 14 beneficial uses listed in the Great Lakes Water Quality Agreement (GLWQA), is presented in Table 1.

ENVIRONMENTAL SETTING

Description

The Maumee River basin drains a total area of 6,586.3 square miles--4,856.3 square miles are in Ohio, 1,260.0 square miles are in Indiana and 470.1 square miles are in Michigan (ODNR, 1960). The Ohio portion of the Maumee River basin is located in all or large areas of fourteen counties and parts of three others. The Area of Concern is in Lucas and Wood counties. Crane and Cedar creeks drain 54.0 and 49.9 square miles, respectively, with Halfway Creek (Silver and Shantee creeks) draining 18.8 square miles from Ohio only. Otter, Wolf, Cedar and Crane creeks drain 7.6, 15.5, 49.9 and 54.0 square miles, respectively. Finally, the Ottawa River watershed (including Ten Mile Creek) covers 178.5 square miles; 45.2 of which are in Michigan.

The mainstem of the Maumee River is approximately 130 miles in total length with 105 miles in Ohio. It begins in Ft. Wayne, Indiana at the confluence of the St. Joseph and St. Marys rivers (Ohio EPA, 1979). Other major tributaries include the Tiffin River and the Auglaize River. The Maumee River flows northeasterly while the majority of its tributaries generally flow north and south into it. The river's mouth is at Toledo where it enters Maumee Bay and the rich sport fishery of Lake Erie's Western Basin.

The highest elevations of 1,100 feet above mean sea level occur in the Michigan portion of the watershed. At the Ohio/Indiana border the elevation of the Maumee River is 707 feet above mean sea level. While at its mouth in Toledo's Maumee Bay, the river is 573 feet above mean sea level, dropping at and average of 1.3 feet per mile (ODNR, 1960).

Most of the basin once was largely covered by the Great Black Swamp, an extensive area of swamp forest with poorly drained soils. Because of the swamp, the Maumee River basin was one of the last large areas of the State to have its swamp forests cleared, then drained. Now, the Maumee River basin leads the State in the number of acres devoted to farming which is the major industry (Ohio EPA, 1979). According to the 1987 Ohio Agricultural Statistics District 10, which wholly encompasses by and represents the majority of the basin, this area was third in the State in corn production, first in soybean production, and first in wheat production (USDA, 1987).

TABLE I: Summary of Environmental Problems for Lower Maumee River

Potential Use Impairment	IJC Criteria For Listing as an "Area of Concern"	Sources/Causes	Significance to the Maumee River RAP
Restrictions on Fish and Wildlife Consumption	When contaminant levels in fish or wildlife populations exceed current standards, objectives or guidelines and public health advisories are in effect for human consumption of fish or wildlife. Contaminant levels in fish and wildlife must be due to contaminant input from the watershed (i.e., lipid-weight, contaminant concentrations in fish and wildlife will exceed lakewide or regional levels).	----- Dura Avenue Landfill	Fish consumption advisory for carp and catfish in all Lake Erie waters due to PCBs. Fish consumption advisory for all species due to PCBs in Ottawa River from RM 5.7 to mouth. Fish consumption advisory for all species due to PCBs in Hecklinger Pond.
Tainting of Fish and Wildlife Flavor	When effluent limits necessary to achieve ambient water quality standards for the anthropogenic substance(s) causing tainting are being exceeded and survey results have identified tainting of fish or wildlife flavor.	-----	None reported.

Potential Use Impairment	IJC Criteria For Listing as an "Area of Concern"	Sources/Causes	Significance to the Maumee River RAP
Degraded Fish and Wildlife Populations	When fish and wildlife personnel have identified degraded fish or wildlife populations due to a cause within the watershed as part of fish and wildlife management programs.	Toledo WWTP, CSOs	Fish community status in free flowing section of Maumee River is good to fair dropping to fair to poor below the Grand Rapids dam pool.
		CSOs, NPS, contaminated sediment	The fish community status in the lower ten miles of Swan Creek is poor to very poor.
		Industrial discharges, land-fill leachate, CSOs, organic enrichment	The fish community status of the Ottawa River is poor to very poor.
		Landfill leachate, industrial dis-charges, water treat-ment plant sludge charges, water treat-ment plant sludge	The fish community status of Otter and Duck creeks is very poor.

Potential Use Impairment	IJC Criteria For Listing as an "Area of Concern"	Sources/Causes	Significance to the Maumee River RAP
Fish Tumors or Other Deformities	One would expect a zero liver tumor incidence rate in fishes from clean locations. However, due to uncertainty in fish movement, other possible causes and experience with field data, a site will be be listed as an Area of Concern when the incidence of neoplastic or pre-neoplastic liver tumors exceeds 2% in bullheads or 3.5% in suckers. A similar approach should be developed for other deformities.	CSOs & WWTP discharge	Elevated frequency of external anomalies observed in Lower Maumee River Mainstem downstream of Swan Creek, in the lower 5 miles of Swan Creek, in the lower 9 miles of the Ottawa River and near the mouth of Otter Creek.
Bird or Animal Deformities or Reproductive Problems	Use of incidence rates of cross-bill syndrome and reproductive failure in populations of colonial birds has not received as much attention as chemical objectives. The incidence rates of cross-bill syndrome and congenital malformations in sentinel wildlife species can be statistically compared between unimpacted control populations and impacted control populations in Areas of Concern (e.g. Green Bay and Saginaw Bay.) A site will be listed as an Area of Concern when incidence rates of cross-bill syndrome, reproductive failure, etc. are significantly (95% probability level) higher than incidence rates at control sites. Further a site will be listed when bald eagle reproduction is less than one eaglet per active nest.	------	None reported

Potential Use Impairment	IJC Criteria For Listing as an "Area of Concern"	Sources/Causes	Significance to the Maumee River RAP
Degradation of Benthos	When the benthic macroinvertebrate community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. Benthic invertebrate community structure and composition are good integrators of ecosystem status. Three examples of utility include: 1) developing an end point using species diversity; 2) quantifying divergence from an expected community, given quantifiable physical and chemical habitat descriptors; and 3) developing an ecosystem objective using benthic community structure. Further, benthic invertebrates are effective for bioassessment of sediment-associated contaminants. It is recommended that both field and laboratory bioassay data and historical information be used to define endpoints for toxicity and bio-availability of of sediment-associated contaminants. A site will be listed when toxicity or bioavailability of sediment-associated contaminants is significantly (95% probability level) higher than controls.	Toledo WWTP, CSOs	The macroinvertebrate community status in the free flowing section of the Maumee River is exceptional to marginally good dropping to only fair below the Grand Rapids dam pool.
		CSOs	The macroinvertebrate community status in the lower ten miles of Swan Creek is fair to poor.
		Industrial discharges, landfill leachate, CSOs	The macroinvertebrate community status in the Ottawa River is fair to poor.
		Landfill leachate, industrial discharges, water treatment plant sludge	The macroinvertebrate community status of Otter and Duck creeks is very poor.
Restrictions on Dredging Activities	When contaminants in sediment exceed standards, guidelines or objectives, and there are restrictions on the disposal of dredged materials. The Great Lakes States have individual policies based on a case-by-case consideration of contaminant levels and deep-water placements. U.S. EPA's criteria for sediment classification are used to help make a determination.		800,000 to 1,000,000 cubic yards of material dredged annually. Sixty percent open lake disposed—the remainder is placed in a CDF.

Potential Use Impairment	IJC Criteria For Listing as an "Area of Concern"	Sources/Causes	Significance to the Maumee River RAP
Eutrophication or Undesirable Algae	When there are persistent water quality problems (e.g., dissolved oxygen depletion of bottom waters, nuisance algal accumulation on bathing beaches, nuisance algal blooms, decreased water clarity, etc.) attributed to accelerated or cultural eutrophication or the area is contributing to the lack of achievement of the Great Lakes phosphorus target loads identified in Annex 3 of the Agreement.	Agricultural land uses, waste water treatment plants, urban runoff, package treatment plants, CSOs and on-site wastewater treatment systems	The Maumee River is the largest single tributary source of phosphorus to Lake Erie from Ohio comprising over 40% of the total annual load.
Restrictions on Drinking Water Consumption or Taste and Odor Problems	The primary concern is public health and potable water supply. Thus, any waters (intended for human consumption) that contain disease-causing organisms or hazardous concentrations of toxic chemicals or radioactive substances in exceedance of standards, objectives, or guidelines will be listed as an Area of Concern. Numerical water quality objectives and standards have been established to protect human health (e.g., ten of the 44 Agreement objectives have human health considerations; if required objectives are not available, priority must be given to establishment of drinking water objectives). Further, a site will be listed as an Area of Concern when taste and odor problems are present (e.g. taste and odor problems due to blue-green algae or phenolic compounds).	Agricultural land uses	Advisories are issued seasonally for elevated nitrate concentrations in communities that utilize the Maumee River as a public drinking supply. Occasional taste and odor problems at Toledo and Oregon water intakes due to blue-green algae blooms.

Potential Use Impairment	IJC Criteria For Listing as an "Area of Concern"	Sources/Causes	Significance to the Maumee River RAP
Beach Closings	When there are persistent beach closings due to contamination from bacteria, fungi or viruses that may produce enteric disorders or eye, ear, nose, throat and skin infections or other human diseases and infections. For example, the State of Ohio has established the following water quality standards for designated bathing waters: 1) the geometric mean fecal coliform content series of not less than five samples within a 30-day period shall not exceed 200 colonies per 100 ml and shall not exceed 400 colonies per 100 ml in more than ten percent of the examples taken during any 30-day period, or 2) the geometric means C. coli content of a series of not less than five samples within a 30-day period shall not exceed 126 colonies per 100 ml and shall not exceed 235 colonies per 100 ml in more than ten percent of the samples taken during any 30-day period.	-----	
Degradation of Aesthetics	When debris, oil, scum or any substance produces a persistent objectionable deposit, unnatural color or turbidity, or unnatural odor.	Agricultural land use, CSOs, urban runoff	Debris and highly turbid water after rainstorms.
Added Costs to Agriculture or Industry	When there are additional costs required to treat the water prior to use for agricultural purposes (i.e. including, but not limited to livestock watering, irrigation and crop-spraying) or industrial purposes (i.e. intended for commercial or industrial applications and non-contact food processing).	-----	None reported.

Potential Use Impairment	IJC Criteria For Listing as an "Area of Concern"	Sources/Causes	Significance to the Maumee River RAP
Degradation of Phytoplankton and Zooplankton Populations	When phytoplankton or zooplankton community structure significantly diverges from unimpacted control sites of comparable physico-chemical characteristics. Phytoplankton and zooplankton populations should also be used to assess the effects of contaminants. Greater emphasis must be placed on ecological toxicology, including use of bioassays and field data. A site will be listed as an Area of Concern when phytoplankton or zooplankton bioassays (e.g., Ceriodaphnia; algal fractionation bioassays) confirm toxicity (significant at the 95% probability level).	-----	Unknown.
Loss of Fish and Wildlife Habitat	When fish and wildlife personnel have identified loss of fish and wildlife habitat due to water quality contamination as part of fish and wildlife management program.	-----	The fish communities are influenced by habitat modifications such as the addition of riprap and channel straightening, but not to a great extent.

The Maumee River basin contains over 320 stream segments which have designated uses published in the State of Ohio Water Quality Standards (Chapter 3745-OAC). Except for one segment of the Auglaize, all rivers and streams in the Maumee River basin are designated as Warmwater Habitat (Ohio EPA, 1990a). Warmwater Habitats are capable of supporting reproducing populations of bass, crappies, sunfish, perch, catfish and other warmwater fish species, as well as associated invertebrates and plants. The segment of the Auglaize River (between State Route 117 and 114) is designated as an Exceptional Warmwater Habitat. This Habitat is able to support outstanding or unusual communities of warmwater fish and associated invertebrates and plants, and to have water quality that also may be particularly good (Ohio EPA 1990a). Two segments are designated State Resource Waters. These are the Tiffin River bordering Goll Woods Preserve and the Maumee River from the Ohio/Indiana border to the Perrysburg bridge. Virtually all stream segments are designated as agricultural and industrial water supplies, and the majority of stream segments are designated for primary contact such as swimming or canoeing. Several segments are designated for secondary contact, where only limited body contact (wading) is recommended. Primary and secondary contact designations are based solely on water depths.

The basin contains 3,942 stream miles (over 41 percent of all Ohio stream miles in the Lake Erie basin), and, because of monitoring and modeling efforts for the State of Ohio Phosphorus Reduction Strategy for Lake Erie (Ohio EPA, 1989a), all stream miles have been assessed for nonpoint source pollution. Additional biological and chemical water quality monitoring efforts are needed, however, to track phosphorus reduction efforts.

There are 39 public lakes of five surface acres or larger in the Maumee River basin. Almost all lakes are an integral part of the river/stream network. Six lakes are of special concern because they are water supply sources in the Maumee River basin. Several lakes have been constructed for wildlife water supplies, and these are concentrated in the Toussaint Creek Wildlife Area, the Ottawa National Wildlife Refuge (both in Ottawa County). Six lakes (Nettle Lake, Metzger Reservoir, Harrison Lake, Wauseon Reservoir #1, Fulton Pond and Swanton Reservoir) are in the Maumee River basin.

Ecoregions

The publication entitled "Ecoregions of the Upper Midwest States" generally is used to describe the natural and man-altered conditions in Ohio (USEPA, 1988). The Eastern Corn Belt Plains and the Huron/Erie Lake Plain ecoregions are representative of most of the basin. The Lower Maumee River AOC is within the Huron/Erie Lake Plain ecoregion (Ohio EPA, 1990b).

The Huron/Erie Lake Plain ecoregion is characterized as a broad, almost level lake plain with some low moraines and beach ridges. There is very little local relief. The stream density is 0.5 miles/square mile. Soils are poorly to very poorly drained. Forested wetlands from the former Black Swamp once covered much of this ecoregion but, historically, have been cleared and drained for agriculture. Cash crop farming is the predominant land use. Other noteworthy land uses are pasture land, wood lots and urban development. The few lakes and reservoirs usually are small. Half of the streams are intermittent and extensively channelized. Channelization reduces the amount of available habitat for biota. Stream water quality problems can be expected from farm chemicals, livestock manure and erosion induced by livestock (USEPA, 1988).

The Eastern Corn Belt Plains ecoregion is distinguished by a gently rolling glacial till plain with moraines, kames and outwash plains. Local relief is usually less than 50 feet. Half of the streams are perennial and many are channelized. The stream density is 0.5 miles/square mile. There are few reservoirs and natural lakes. Seventy-five percent of the area of this ecoregion is used for cropland. Pasture, wood lots and urban are other noteworthy land uses. The soils mainly are from glacial till and tend to be light in color and acidic. Water quality problems can be expected from herbicides, insecticides, fertilizers and manure which can be delivered more quickly to streams via artificial drainage. Channelization reduces the diversity of habitat for stream biota.

Land Use and Nonpoint Source Pollution

A wide variety of land uses contribute an equivalent amount of nonpoint and point source pollutants which affect the surface and ground water resources in the basin, and, ultimately, the water quality of Lake Erie. The Maumee River basin has the most homogeneous land use pattern of any basin in Ohio, as row crop agriculture is distributed almost evenly across the landscape outside urbanized areas. Urban nonpoint source pollution effects are distributed evenly between the surface runoff, construction sites, storm sewers, and sanitary sewer subcategories. Streams usually receive pollutants from more than one major nonpoint source pollution category. Also, many stream segments receive nonpoint source pollutants from several subcategories of each contributing major category.

Agriculture, especially crop production, impairs more stream miles in the basin than any other type of nonpoint source pollution category. Agriculture and hydromodification are spread throughout the Maumee River basin in a homogeneous fashion. Sediment, nutrients and pesticides are nonpoint source pollutants associated with crop production in the basin, and one nutrient, phosphorus, is of particular concern. Phosphorus promotes eutrophication in Lake Erie, and the Maumee River basin contributes more phosphorus to the Lake than all other nonpoint sources in Ohio combined (Ohio EPA, 1989a).

Land disposal, in-place pollutants, urban and silviculture nonpoint pollution source categories also affect a significant amount of stream miles, while the resource extraction category impairs comparatively few stream miles. Urban nonpoint sources are scattered throughout the basin. Various manufacturing industries, scattered throughout the Region and centered in Toledo, also are important to the regional and State economy.

Hydromodification, done to enhance crop production, is the second most pervasive nonpoint source pollution category in the basin. Channelization is by far the most significant source. Stream segments affected by hydromodification are closely associated with stream segments affected by agriculture. These two nonpoint source pollution categories are closely associated because artificial drainage is a necessary component of the intensive agriculture practiced on the poorly drained and level soils of the basin.

Land disposal is the third most significant nonpoint source pollution category in the basin. On-site wastewater treatment is the only significant land disposal subcategory.

Silviculture, resource extraction and in-place pollutants affect comparatively few stream miles. Although not affecting a great number of miles, these source categories may have significant local effects. For example, in-place pollutants, i.e., heavily polluted sediments, are a major problem near the mouth of the Maumee River. These sediments are one of the many reasons the International Joint Commission of the United States and Canada has designated the Maumee River an "area of concern," unable to fulfill potential uses or support beneficial aquatic life.

Soils, Geology and Ground Water

The Maumee River basin has extensive ground water resources, available from unconsolidated glacial sand and gravel deposits or underlying carbonate bedrock aquifers. In the far northwest corner of the basin, in Williams County and western Fulton and Defiance counties, ground water wells may yield 500 gallons per minute (gpm) from widespread sand and gravel deposits. Wells in the area immediately adjacent to these deposits in eastern Fulton and Defiance counties and western Henry and Lucas counties often yield between 100 to 500 gpm. The quality of ground water varies, although water is often high in dissolved solids (especially sulfur) over most of the basin (Ohio EPA, 1990b).

The basin's soils are developed in glacial till, outwash or lacustrine materials and are some of the most productive agricultural soils in Ohio. Most of these soils are very poor to moderately drained due to the medium to high clay content. Conventional tillage practices, which subject the soil to erosion, are employed on about 80 percent of the fields.

Due to the complexity and expense of ground water data collection, the amount and quality of ground water data available for the basin is less than it is for surface water resources. In spite of these problems, it is known that agricultural activities, on-site wastewater treatment systems and landfills are the primary nonpoint source categories impacting ground water in the Maumee River basin (Ohio EPA, 1990b).

Nonpoint source pollution impact private wells in twelve counties in the Maumee River basin. Nitrates, the most common suspected problem pollutant, impact ground water areas throughout the basin. Though seldom listed, agricultural activities are probably the main source of nitrate pollutants (Ohio EPA, 1990b). Nitrates impact private wells more often because of improper well construction than actual ground water contamination.

On-site wastewater treatment, urban sources and oil and gas extraction are reported also to have impacted ground water in some areas in the basin. These sources contribute a wide array of pollutants, including metals and brines, pathogens and organic materials. A sanitary landfill is impacting an aquifer under Sylvania Township in Lucas County. In Lucas County, three areas that yield ground water underlying the adjoining townships of Monclova, Spencer and Springfield are impacted by on-site wastewater treatment contributing pathogens, which are a frequent problem.

Various ground water areas scattered throughout the basin are suspected to be affected by on-site wastewater treatment and landfills, but nitrate problems outnumber these problem areas (Ohio EPA, 1990b).

WATER USES

STREAM SEGMENTS OF THE MAUMEE RIVER RAP AREA

The Lower Maumee River and its tributaries are divided into a number of segments, according to their drainage areas. Each stream segment is classified as being a part of a major drainage basin. In the Maumee RAP Area, the basin is generally the Maumee River. A few streams in the RAP Area actually flow directly into the Maumee Bay/Lake Erie and are not tributary to the Maumee River. Within each basin, stream segments may be classified as part of a subbasin. Each segment drains one or more watersheds.

There are three systems in use for classifying watersheds. These are:

1. Ohio EPA uses the Planning and Engineering Data Management System for Ohio (PEMSO) system. Each stream segment has a unique PEMSO number.

2. TMACOG uses smaller watersheds, which are generally a subset of the PEMSO watersheds.

3. The third system is Land Resources Information System (LRIS), developed for the 208 program, and further defined for the Lake Erie Wastewater Management Study (LEWMS) (USCOE, 1973). LRIS watersheds are usually, but not always, the same as TMACOG's.

Stream segments are also categorized by their uses. They are assigned aquatic life use designations by the Ohio EPA, and each stream's water quality standards are based on its' use designations. All of the Maumee RAP Area streams are classified Warmwater Habitat (WWH), Agricultural and Industrial Water Supply, and Primary Contact Recreation (PCR). Any portions of the AOC that are within 500 yards of an existing public water supply intake are designated Public Water Supply.

A listing of RAP Area stream segments and their classifications is given in Table 2. The stream reaches are shown in Figure 2.

TABLE 2

RAP AREA STREAM SEGMENTS AND USE DESIGNATIONS

STREAM, BASIN, AND SUB-BASIN	WATERSHED NUMBERS	STREAM SEGMENT USES	LENGTH (Miles)
Ai Creek BASIN: Maumee SUBBASIN: Swan NOTES: Swan Creek, West Fork RAP? Yes	TMACOG: 007 LRIS: 007 PEMSO: 410102	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	9.10
Ayres Creek BASIN: Lake Erie SUBBASIN: Crane Creek NOTES: RAP? Yes	TMACOG: 033 LRIS: 033 PEMSO: 1610302	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	0.60
Blue Creek BASIN: Maumee SUBBASIN: Swan NOTES: RAP? Yes	TMACOG: 038, 040 LRIS: 038, 040 PEMSO: 410103	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	11.90
Cairl Creek BASIN: Maumee SUBBASIN: Swan/Wolf NOTES: RAP? Yes	TMACOG: 042 LRIS: 042 PEMSO: 410132	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	7.40
Cedar Creek BASIN: Lake Erie SUBBASIN: Cedar NOTES: RAP? Yes	TMACOG: 032 LRIS: 032 PEMSO: 1610303	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	8.50
Crane Creek BASIN: Lake Erie SUBBASIN: Crane NOTES: RAP? Yes	TMACOG: 033 LRIS: 033 PEMSO: 1610302	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	12.70
Delaware Creek BASIN: Maumee SUBBASIN: Maumee River NOTES: RAP? Yes	TMACOG: 013 LRIS: 013 PEMSO: 410133	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	2.50
Dry Creek BASIN: Lake Erie SUBBASIN: Cedar Creek NOTES: RAP? Yes	TMACOG: 032 LRIS: 032 PEMSO: 1610303	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	11.50

TABLE 2 (continued)
RAP AREA STREAM SEGMENTS AND USE DESIGNATIONS

STREAM, BASIN, AND SUBBASIN	WATERSHED NUMBERS	STREAM SEGMENT USES	LENGTH (Miles)
Duck Creek BASIN: Maumee SUBBASIN: Maumee River NOTES: RAP? Yes	TMACOG: 015 LRIS: 015 PEMSO: 410133	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	3.00
Gail Run BASIN: Maumee SUBBASIN: Swan NOTES: RAP? Yes	TMACOG: 008 LRIS: 008 PEMSO: 410101	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	4.70
Grassy Creek BASIN: Maumee SUBBASIN: Maumee River NOTES: RAP? Yes	TMACOG: 046,045 LRIS: 046,045 PEMSO: 410133	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	2.50
Halfway Creek BASIN: Maumee SUBBASIN: North Maumee Bay NOTES: RAP? Yes	TMACOG: 025,022,021 LRIS: 025,022,021 PEMSO: 410302	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	3.50
Harris Ditch BASIN: Maumee SUBBASIN: Swan/Blue NOTES: Swan Creek, South Fork RAP? Yes	TMACOG: 075 LRIS: 075 PEMSO: 410103	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	5.60
Henry Creek BASIN: Lake Erie SUBBASIN: Crane Creek NOTES: RAP? Yes	TMACOG: 033 LRIS: 033 PEMSO: 1610302	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	9.00
Hill Ditch BASIN: Maumee SUBBASIN: Ottawa NOTES: RAP? Yes	TMACOG: 202 LRIS: 202 PEMSO: 411331	HABITAT: WATER SUPPLY: RECREATIONAL: STATE RESOURCE? No	4.75
Lake Erie Watershed #1 BASIN: Maumee SUBBASIN: Ottawa NOTES: RAP? Yes	TMACOG: 030 LRIS: 030 PEMSO: 411133	HABITAT: WATER SUPPLY: RECREATIONAL: STATE RESOURCE? No	

TABLE 2 (continued)
RAP AREA STREAM SEGMENTS AND USE DESIGNATIONS

STREAM, BASIN, AND SUBBASIN	WATERSHED NUMBERS	STREAM SEGMENT USES	LENGTH (Miles)
Lake Erie Watershed #2 BASIN: Maumee SUBBASIN: Ottawa NOTES: RAP? Yes	TMACOG: 031 LRIS: 031 PEMSO: 411364	HABITAT: WATER SUPPLY: RECREATIONAL: STATE RESOURCE? No	
Lake Erie Watershed #3 BASIN: Maumee SUBBASIN: Ottawa NOTES: RAP? Yes	TMACOG: 034 LRIS: 034 PEMSO: 411363	HABITAT: WATER SUPPLY: RECREATIONAL: STATE RESOURCE? No	
Little Cedar Creek BASIN: Lake Erie SUBBASIN: Cedar Creek NOTES: RAP? Yes	TMACOG: 032 LRIS: 032 PEMSO: 1610303	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	2.50
Little Crane Creek BASIN: Lake Erie SUBBASIN: Crane Creek NOTES: RAP? Yes	TMACOG: 033 LRIS: 033 PEMSO: 1610302	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	3.50
Maumee River, Mouth-Perrysburg BASIN: Maumee SUBBASIN: Maumee River NOTES: RAP? Yes	TMACOG: 013,014, 15,47 LRIS: 013,14, 015,047 PEMSO: 410133	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? Yes	6.90
Maumee River, Perrysburg-Waterville BASIN: Maumee SUBBASIN: Maumee River NOTES: RAP? Yes	TMACOG: 079, 044 LRIS: 079, 044 PEMSO: 410133	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE: Yes	
Maumee River, Waterville-BG Water Intake BASIN: Maumee SUBBASIN: Maumee River NOTES: RAP? Yes	TMACOG: 078, 043 LRIS: 043 PEMSO: 410235	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? Yes	3.50
Mosquito Creek BASIN: Maumee SUBBASIN: Swan/Blue NOTES: RAP? Yes	TMACOG: 040 LRIS: 040 PEMSO: 410103	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	0.80

TABLE 2 (continued)
RAP AREA STREAM SEGMENTS AND USE DESIGNATIONS

STREAM, BASIN, AND SUBBASIN	WATERSHED NUMBERS	STREAM SEGMENT USES	LENGTH (Miles)
Ottawa River at Toledo (Berdan to UT) BASIN: Maumee SUBBASIN: Ottawa NOTES: RAP? Yes	TMACOG: 005 LRIS: 005 PEMSO: 411331	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	3.50
Ottawa River at Toledo (Mouth to Berdan) BASIN: Maumee SUBBASIN: Ottawa NOTES: RAP? Yes	TMACOG: 005 LRIS: 005 PEMSO: 411331	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	7.40
Ottawa River at Toledo (UT to N. Br) BASIN: Maumee SUBBASIN: Ottawa NOTES: RAP? Yes	TMACOG: 005,004 LRIS: 005,004 PEMSO: 411331	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	8.61
Otter Creek BASIN: Maumee SUBBASIN: Maumee Bay NOTES: RAP? Yes	TMACOG: 028 LRIS: 028 PEMSO: 1610364	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	6.00
Prairie Ditch BASIN: Maumee SUBBASIN: Ottawa River NOTES: RAP? Yes	TMACOG: 002 LRIS: 002 PEMSO: 410301	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	5.90
Reitz Road Ditch BASIN: Maumee SUBBASIN: NOTES: RAP? Yes	TMACOG: 078 LRIS: 078 PEMSO: 411235	HABITAT: WATER SUPPLY: RECREATIONAL: STATE RESOURCE? No	
Shantee Creek BASIN: Maumee SUBBASIN: North Maumee Bay NOTES: RAP? Yes	TMACOG: 020 LRIS: 020 PEMSO: 410302	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	4.60
Sibley Creek BASIN: Maumee SUBBASIN: Ottawa NOTES: RAP? Yes	TMACOG: 005 LRIS: 005 PEMSO: 411331	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	5.20

TABLE 2 (continued)
RAP AREA STREAM SEGMENTS AND USE DESIGNATIONS

STREAM, BASIN, AND SUBBASIN	WATERSHED NUMBERS	STREAM SEGMENT USES	LENGTH (Miles)
Silver Creek BASIN: Maumee SUBBASIN: North Maumee Bay NOTES: RAP? Yes	TMACOG: 023 LRIS: 023 PEMSO: 410302	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	7.30
Swan Creek (Mouth to Blue Creek) BASIN: Maumee SUBBASIN: Swan Creek NOTES: RAP? Yes	TMACOG: 012,010,041 LRIS: 012,010,041 PEMSO: 410132	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	22.20
Swan Creek above Ai Creek BASIN: Maumee SUBBASIN: Swan Creek NOTES: RAP? Yes	TMACOG: 008 LRIS: 008 PEMSO: 410101	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	7.93
Swan Creek above Blue Creek BASIN: Maumee SUBBASIN: Swan Creek NOTES: RAP? Yes	TMACOG: 039 LRIS: 039 PEMSO: 410131	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	8.40
Tenmile Creek above North Branch BASIN: Maumee SUBBASIN: Ottawa River NOTES: RAP? Yes	TMACOG: 001,003 LRIS: 001,003 PEMSO: 410301	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	34.80
Tenmile Creek, North Branch BASIN: Maumee SUBBASIN: Ottawa River NOTES: RAP? Yes	TMACOG: 006 LRIS: 006 PEMSO: 410301	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	6.50
Wolf Creek BASIN: Maumee SUBBASIN: Swan NOTES: RAP? Yes	TMACOG: 011 LRIS: 011 PEMSO: 410132	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	7.00
Wolf Creek BASIN: Maumee SUBBASIN: Maumee Bay NOTES: RAP? Yes	TMACOG: 029 LRIS: 029 PEMSO: 1610364	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR STATE RESOURCE? No	2.80

EXISTING WATER USES

PUBLIC WATER SUPPLY

One of the surface water uses in the Lower Maumee River AOC is water supply. The primary use is for public water supply. Several industries use surface waters for industrial water supply as well.

As far as public water supply is concerned, two surface water bodies in the AOC are the sources of four public water supply systems. The Maumee River is the public water source for both the City of Bowling Green and the Village of Waterville. Lake Erie is the source for both the City of Oregon and the City of Toledo. According to 1980 population estimates, these four systems service a combined population of just over 524,000.

Three of the four public water supply systems are located in Lucas County. Most of the county is serviced by these systems except for Jerusalem, Richfield, Harding and Providence Townships and portions of Spencer and Swanton Townships. The three lower townships of Monroe County, Michigan and the northern portion of Wood County, Ohio are also serviced by these water supply systems. The Village of Whitehouse uses ground water as its public water supply source.

Oregon

The City of Oregon obtains its water supply directly from Lake Erie. The water is pumped from the low service pumping station in Jerusalem Township to the Water Treatment Plant (WTP) where approximately 8.0 million gallons per day (mgd) are purified and softened.

After treatment, a portion of the water is stored at the water treatment plant in a 1.5 million gallon (MG) reservoir and a 1.0 MG elevated tank at Coy Road. The rest is distributed to approximately 7,000 customers and serves a total population of 25,000 in Oregon and parts of Lucas, Wood and Ottawa Counties. Specifically, Oregon supplies water to the City of Oregon, the Village of Harbor View, the Village of Genoa and a portion of the City of Northwood.

Overall, the Oregon WTP has been able to maintain good water quality. Basically, the raw lake water is softened, disinfected and clarified before it is suitable for public use.

The three major water quality problems which cause the treatment plant the most trouble are sediments, turbidity and phosphates. Sediments and turbidity are problematic in the treatment process because they must be removed from the water. Therefore, the greater the amount of suspended sediment and turbidity, the greater the effort and cost required to remove them.

Phosphates create problems for the WTP because they stimulate algae growth. Algae blooms cause taste and odor problems in potable water. When water containing increased numbers of algal cells or their metabolic and decay products (or other organic matter) is chlorinated for disinfection purposes, increased levels of trihalomethane result (ODNR, 1985b; TMACOG, 1983b; Merrill, 1988).

Toledo

The City of Toledo obtains its water directly from Lake Erie. The water is pumped from the low service pumping station in Jerusalem Township to the Collins Park Water Treatment Plant (WTP) in East Toledo. The Collins Park WTP purifies and softens approximately 120 mgd of lake water.

The Toledo water system constitutes the largest physical plant in the region for supplying treated water. Toledo supplies water to the entire county except Jerusalem, Richfield, Harding and Providence Townships, parts of Spencer and Swanton Townships and those areas serviced by the Oregon WTP. It also supplies water to portions of northern Wood County and the lower Townships of Monroe County, Michigan. Specifically, the Cities of Toledo, Sylvania, Maumee, Perrysburg, Rossford, Luna Pier and a portion of the City of Northwood receive their water from Toledo. In addition, the Villages of Holland, Ottawa Hills and Walbridge are served by Toledo. Toledo supplies water to just under 120,000 service connections and services a total population of approximately 464,000.

Overall, Collins Park WTP has been able to maintain good water quality. The lake water is softened, clarified and disinfected before it is distributed as public supply. The water quality problems that give the treatment plant the most trouble are the same as those already mentioned with regard to the Oregon WTP, sediments, turbidity and phosphates. Occasional taste and odor problems stemming from excessive algae growth have been the primary problems for the treatment plant (ODNR, 1985b; TMACOG, 1983b; Merrill, 1988).

Bowling Green

The Bowling Green Water System is the only public water supply system in the AOC which is located in Wood County. Approximately 90% of the public water used in Wood County is provided by surface water. Of that 90%, 80% is supplied by the Maumee River.

Bowling Green obtains its supply directly from the Maumee River. The City of Bowling Green WTP has the capacity to soften and purify 6.0 mgd.

After treatment, the water is distributed to just over 5,000 service connections and serves a population of approximately 30,000 in Wood County. Specifically, the City of Bowling Green and the surrounding area of Wood County, the Villages of Haskins, Tontogany, Portage and the Miltonville area along River Road are supplied by the Bowling Green water system.

The river water is softened, disinfected and clarified before it is distributed. The Bowling Green Water System has recognized water quality problems which are related to the water quality of the Maumee River. Sediment, turbidity, phosphates, nitrates and herbicides are the most problematic.

High levels of turbidity require great efforts for removal of sediments. Turbidity units can reach very high levels in the Maumee River, especially in the spring, fall and during storm events.

Nitrates and herbicides present a difficult problem for treatment because they cannot be removed from the water with current installed treatment technologies. The best that can be done by the WTP is to dilute the water to reduce the concentrations of these substances. Therefore, there are times when the Bowling Green water supply contains high levels of nitrates and herbicides. This occurs at those times when the Maumee River has high levels of these substances which normally happens in the spring. The City has built a reservoir which helps dilute high nitrate water and provide greater reserve capacity in the event of a chemical spill on the river or abnormally low flow preventing the plant from pumping from the river.

Bowling Green occasionally has trouble with trihalomethanes. This usually occurs when there are increased amounts of algae present in the Maumee River. Algae cause increased amounts of organic matter in water. Chlorination of this organic matter during the disinfection process increases the formation of trihalomethane (ODNR, 1985b; TMACOG, 1983b; Merrill, 1988).

Waterville

The Village of Waterville obtains its water supply directly from the Maumee River. The river water is pumped to the water treatment facilities where it is softened and purified. The WTP treats about 0.8 mgd.

The treated water is distributed to approximately 1,500 service connections serving a population of approximately 5,300 in the Village of Waterville and Lucas County. Specifically, portions of Monclova and Waterville Townships are serviced by this system in addition to the Village of Waterville. The current facilities will probably not be able to meet future needs without expansion. Therefore, the system may eventually be replaced by the Toledo system.

The river water is softened, disinfected and clarified before distribution. Generally, the water quality maintained by the treatment facility has been good. However, there have been cases, usually in the spring, when nitrate and trihalomethane levels have exceeded drinking water standards. The water quality problems which cause the most trouble for the WTP are sediment, turbidity, phosphates, nitrates and herbicides. These problems were discussed previously in the section on the City of Bowling Green WTP (ODNR, 1985b; TMACOG, 1983b; Merrill, 1988).

Summary

Generally speaking, the problems experienced by each of the public water supply systems can be attributed to sediment, nutrient and phosphorus loadings to the Maumee River. Nonpoint sources of pollution primarily are responsible for these loadings. These nonpoint sources include agricultural runoff and urban storm-water runoff. A summary table which outlines the various characteristics of each public water systems has been provided (Table 3).

TABLE 3

SUMMARY OF PUBLIC WATER SUPPLY SYSTEMS IN THE RAP AREA

CHARACTERISTICS	OREGON	TOLEDO	WATERVILLE	BOWLING GREEN	TOTAL
Source of Supply	Lake Erie	Lake Erie	Maumee River	Maumee River	
Est. Pop. Served	25,000	463,940	5,255	30,000	524,195
Customers Served	6,800	118,585	1,500	5,287	132,172
Area Served	Oregon, Harbor View, Genoa, Northwood*, Wood County*, Lucas County*, Ottawa County*	Toledo, Sylvania, Holland, Perrysburg, Ottawa Hills, Maumee, Walbridge, Rossford, Northwood*, Monroe County*, Wood County*, Lucas County*	Waterville, Monclova Township*, Waterville Township*	Bowling Green, Haskins, Tontogany, Wood County*, Miltonville Area#	
Type of Treatment	Softening & Disinfection	Softening & Disinfection	Softening & Disinfection	Softening & Disinfection	
Water Quality Problems	Turbidity, Sediments & Phosphates	Turbidity, Sediments & Phosphates	Turbidity, Nitrates, Sediments & Herbicides	Turbidity, Nitrates, Sediments & Herbicides	

TABLE 3 (Continued)

SUMMARY OF PUBLIC WATER SUPPLY SYSTEMS IN THE RAP AREA

CHARACTERISTICS	OREGON	TOLEDO	WATERVILLE	BOWLING GREEN	TOTAL
Source of Supply	Lake Erie	Lake Erie	Maumee River	Maumee River	
TREATMENT PROCESS					
Coagulation/ Recarbonization	Alum, Lime, Soda Ash	(Hydraulic Mixing) Alum, Lime, Soda Ash	Alum, Lime	Ferric Chloride, Lime	
Flocculation	Slow Mechanical Mix	Slow Mechanical Mix	Slow Mechanical Mix	Slow Mechanical Mix	
Filtration	Rapid Sand Filters	Rapid Sand Filters	Rapid Sand Filters	Rapid Sand Filters	
Taste & Order Control	Activated Carbon, Chlorine Dioxide	Activated Carbon, Chlorine Dioxide	Activated Carbon, Chlorine Dioxide	Potassium Permangenate, Chlorine Dioxide, Activated Carbon	
Corrosion Control & Stabilization	Phosphate Compounds	Phosphate Compounds, Carbon Dioxide	@	Carbon Dioxide	
Fluoridation	Sodium Silicofluoride	Sodium Silicofluoride	Sodium Fluoride	Hydroflusilicic Acid	
Disinfection	Chlorine	Chlorine	Chlorine	Chlorine	

* = Portions of
# = Area along River Road
@ = Unspecified

Source: TMACOG Report, "Water Supply Systems in the Toledo Metropolitan Area," June, 1983.

SPORT AND COMMERCIAL FISHING

The surface waters in the Area of Concern are used for sport and commercial fishing. The primary areas for sport fishing are the Maumee River and Maumee Bay, however, sport fishing occurs throughout the Area of Concern. Commercial fishing has been limited to the Bay.

Data on sport fishing in the Maumee River are collected by the Ohio Department of Natural Resources, Division of Wildlife. Spring Creel Surveys are taken periodically. A summary of these surveys from 1975 to 1987 has been provided (Table 4). The increase of walleye caught in 1987 probably reflects the good year of spawning experienced in 1982.

Walleye and white bass are the principle sport fish in the Maumee River. The spring walleye run is an important sport fishing event which has drawn people from as far away as Alaska. Other fish which can be found in the Maumee include yellow perch, channel catfish, smallmouth bass, sauger and white perch.

The ODNR, Division of Wildlife does not take creel surveys for other streams in the AOC, therefore, it would be difficult to estimate the number of sport fish caught in this area, but sport fishing is widespread throughout the AOC. The selection of a fishing site is only limited by the sport fisherman's experience and imagination. Limited fishing occurs in the Ottawa River and Swan Creek. Sport fishermen are commonly found at private ponds and small lakes such as Evergreen Lake in the Oak Openings Metropark.

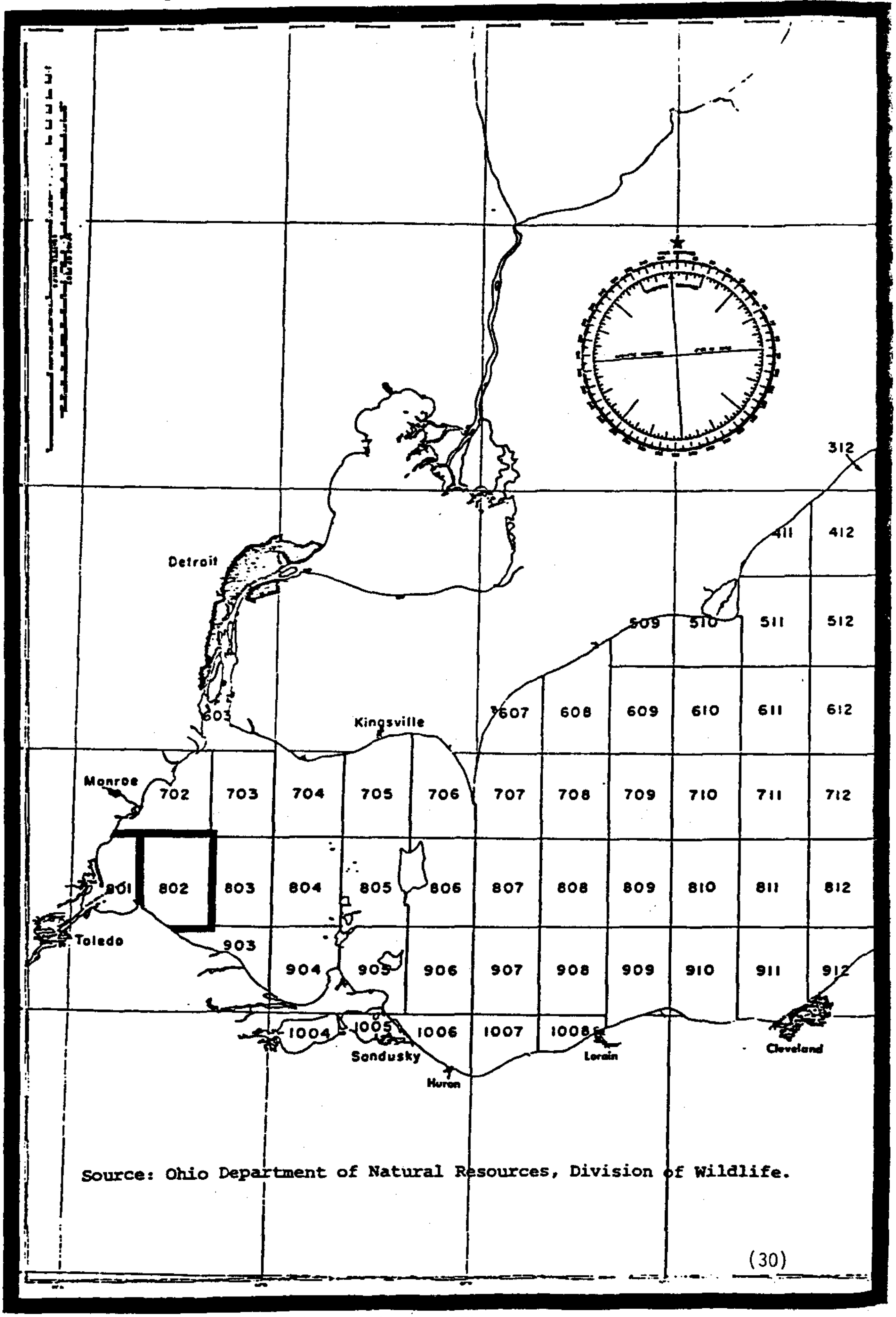
Both sport and commercial fishing occur in the Maumee Bay. The Western Basin of Lake Erie is considered one of the best fishing locations on the Great Lakes. It is well known for its walleye fisheries, being called the walleye capital of the world. Although the walleye fisheries had declined in the early 1970's, they have made a comeback since 1975. The ODNR, Division of Wildlife, collects sport and commercial fishing data for Maumee Bay and Lake Erie. ODNR grids 801 and 802 are at least partially located in the Area of Concern (Figure 3). Summary data on sport boat angler hours and harvest from 1980 to 1987 have been provided (Table 5). A summary of commercial harvest has also been provided (Table 6). Yearly variations are largely due to the number of surveys taken in a given year.

An indication of the importance of fishing as a water use in the Area of Concern might be obtained by looking at the number of fishing related organizations. To date, 8 sportsmen organizations and 11 charter boat services have been identified and it is likely that more exist.

A public health advisory was issued in 1987 and 1988, against consumption of carp and channel catfish taken from Lake Erie, which affects Maumee Bay and the estuarine portion of the Maumee River. PCB levels have been detected in these species which frequently exceed the U.S. Food and Drug Administration's (USFDA) tolerance limit of two parts per million in the edible portions. While compliance with the advisory is voluntary for sport fishermen, USFDA has charged commercial fisheries with ensuring that fish which may enter interstate commerce fall within federal tolerance limits for contaminants.

Fish kills are investigated by the ODNR Division of Wildlife. An annual report, Water Pollution, Fish Kill, and Stream Litter Investigations, is published, which summarizes the fish kills for the year. In the 1987 report, Table 2 ("Wild Animal Kills Resulting from Water Pollution Incidents Investigated in 1987) notes that 2,227 fish and invertebrates were killed in Swan Creek on July 30, 1987. The suspected pollutant was sewage.

Ohio Department of Natural Resources Wildlife Grid FIGURE 3



Source: Ohio Department of Natural Resources, Division of Wildlife.

TABLE 4

SUMMARY OF ANGLER HOURS, CATCH AND CATCH RATES IN THE SPRING CREEL SURVEYS: MAUMEE RIVER FROM 1975-1987

	ANGLER HOURS			WALLEYE		WHITE BASS	
Year	Walleye*	White Bass@	TOTAL	Catch*	CPUE$	Catch@	CPUE$
1975	112,500	43,800	214,100	15,475	.14	36,731	.84
1976	36,700	81,600	186,800	5,336	.15	124,235	1.52
1977	41,600	40,800	125,700	6,163	.15	79,995	2.00
1978#	73,900	---	---	22,747	.29	---	---
1979#	184,800	---	---	33,614	.18	---	---
1980	155,800	46,700	230,800	38,442	.23	87,700	1.34
1981	161,700	93,200	298,200	21,415	.11	165,500	1.48
1982	201,400	133,100	368,900	37,300	.16	172,372	1.05
1983+	---	---	---	---	---	---	---
1984	143,200	59,900	210,100	28,899	.17	137,091	1.56
1985+	---	---	---	---	---	---	---
1986+	---	---	---	---	---	---	---
1987	247,000	56,100	339,500	69,871	.25	66,633	.75
TOTAL	1,358,600	555,200	1,974,100	279,262		870,257	

* Anglers Seeking Walleye.
@ Anglers Seeking White Bass.
\# Walleye Fishery Only Surveyed.
\+ No River Surveys were Conducted.
$ Catch Per Unit of Effort

Source: Unpublished data. Ohio Department of Natural Resources, Division of Wildlife.

TABLE 5

SPORT BOAT ANGLER HOURS AND HARVEST 1980-87
GRIDS 801 & 802: MAUMEE BAY AND LAKE ERIE

Year	Angler Hours	Yellow Perch	Walleye	White Bass	Freshwater Drum	Channel Catfish	Smallmouth Bass	Other Fish	TOTAL HARVEST
1980	1,006,855	2,526,620	314,388	6,968	17,221	4,034	0	244	2,869,475
1981	4,313	2,702	0	4	65	71	0	124	2,966
1982	960,900	2,158,666	179,764	4,946	11,870	6,014	0	3,555	2,364,815
1983	223,234	248,315	31,826	43,778	1,276	1,942	0	0	327,137
1984	680,364	958,563	464,837	19,029	2,215	2,500	71	58	1,447,273
1985	283,056	503,427	126,506	1,472	2,392	3,658	0	2,364	639,819
1986	487,839	734,629	161,162	4,308	9,070	6,141	0	15,023	930,333
1987	362,893	406,745	149,886	24,757	5,539	4,415	0	0	591,342
TOTAL	4,009,454	7,539,667	1,428,369	105,262	49,648	28,775	71	21,368	9,173,160

Source: Unpublished data. Ohio Department of Natural Resources, Division of Wildlife.

TABLE 6

COMMERCIAL HARVEST IN POUNDS 1983-86

GRIDS 801 & 802: MAUMEE BAY AND LAKE ERIE

Type of Fish	1983	1984	1985	1986	Total
Yellow Perch	12,245	2,358	6,104	26,504	47,211
Carp	128,080	116,960	301,606	64,291	610,937
White Bass	143,692	212,768	250,007	84,661	691,128
Channel Catfish	14,656	19,166	34,841	13,897	82,560
Drum	45,304	13,025	19,189	23,218	100,736
Bullhead	9,815	12,901	16,859	14,822	54,397
Buffalo	3,654	5,991	7,450	4,261	21,356
Goldfish	0	414	1,011	295	1,720
Suckers	14,949	3,171	6,573	3,300	27,993
Quillback	12,205	13,101	10,904	9,416	45,626
Gizzard Shad	125	0	2,424	0	2,549
White Perch	14,755	42,208	38,019	28,533	123,515
Total	399,480	442,063	694,987	273,198	1,809,728

Source: Unpublished data. Ohio Department of Natural Resources, Division of Wildlife.

COMMERCIAL NAVIGATION

One of the most important uses of the Maumee River and Bay is commercial navigation. The Toledo shipping channel which begins at river mile (RM) 7.0 near the I-75 bridge and extends out into the Maumee Bay to lake mile (LM) 18 is vitally important to the economic well being of the region and is the only commercial navigation route in the AOC (Figure 4). Toledo is the third largest port on the Great Lakes (Hull Consulting, 1987). Its location makes it a logical turn around point for St. Lawrence Seaway traffic and it serves one of the largest rail centers in the nation. (Horowitz, et al, 1975). Various goods are shipped to and received from domestic, Canadian and overseas locations. Summaries of domestic and Canadian and over-seas cargo shipped from the port from 1976 to 1986 have been provided (Tables 7 & 8).

The channel is 18 miles long, 500 feet wide and 28 feet deep in the Maumee Bay. The Maumee River channel is 7 miles long, 400 feet wide and 27 feet deep (Hull Consulting, 1987). Those depths are maintained by the U.S. Army Corps of Engineers (COE) through frequent channel dredging. Due to the heavy sediment loading to the Maumee River and the shallowness of the Western Lake Erie Basin (25 foot average) (Hull Consulting, 1987), sedimentation is the primary obstacle for navigation on the Maumee River and Bay.

The COE dredges approximately one million cubic yards of materials from the channel each year. Prior to 1975, those materials were disposed of in confined disposal facilities (CDF) or by open lake disposal. From 1975 to 1985, dredge spoils were placed in the currently active CDF, Facility #3, to protect the environment from contaminated sediments. In 1985, U.S. EPA approved open lake disposal of materials dredged from less polluted areas of the channel if chemical analysis showed that the materials to be disposed of were similar to sediment in certain areas of the Western Basin where disposal had occurred in the past.

Open lake disposal requires 401 certification from the Ohio EPA. The 1987 401 Certification stated that it is the intention of the Ohio EPA to condition future 401 certifications to eventually phase out open lake disposal. However, it is the responsibility of the City of Toledo and the Toledo-Lucas County Port Authority to develop reuse alternatives for dredged materials.

TABLE 7

SEAPORT STATISTICS: 1976-1986, FOR SEASON THROUGH DECEMBER 31

TOLEDO HARBOR DOMESTIC & CANADIAN CARGO (Short Tons)

Commodity	1976 Season	1977 Season	1978 Season	1979 Season	1980 Season	1981 Season
Coal	14,542,037	13,393,777	14,194,776	14,570,580	12,588,982	12,159,605
Iron Ore	4,804,137	3,541,824	5,649,765	5,331,354	2,784,646	3,956,278
Newsprint	48,024	56,324	44,307	47,923	37,900	38,820
Pig Iron	57,328	18,818	46,851	12,541	19,901	34,015
Salt	264,052	325,312	266,089	261,988	159,438	70,465
Cement	88,645	104,874	—	—	—	—
Grain	1,936,632	1,872,738	2,547,278	2,592,774	3,766,650	3,353,742
Petro.Prod.	862,398	804,733	793,179	879,412	609,794	390,143
Oth.Dry Bulk	116,609	122,100	211,677	260,231	548,089	854,121
Oth.Liq.Bulk	8,294	—	—	—	—	—
Gen. Cargo	—	—	—	—	—	—
TOTAL	22,728,156	20,240,500	23,753,922	23,956,803	20,515,400	20,857,189

Commodity	1982 Season	1983 Season	1984 Season	1985 Season	1986 Season	TOTAL
Coal	8,803,621	11,155,130	12,042,839	10,498,225	10,675,904	134,625,476
Iron Ore	2,653,474	2,889,808	3,559,609	2,940,010	3,178,676	41,289,581
Newsprint	—	—	31,434	21,050	12,880	338,662
Pig Iron	6,353	16,024	18,498	25,436	14,010	269,775
Salt	192,965	23,721	257,955	215,582	203,952	2,241,519
Cement	—	—	—	—	—	193,519
Grain	2,410,340	1,052,130	1,471,378	1,602,664	916,678	23,523,004
Petro.Prod.	339,636	575,059	384,677	420,874	206,382	6,266,287
Oth.Dry Bulk	740,966	703,250	890,556	951,027	899,262	6,297,888
Oth.Liq.Bulk	—	—	—	—	6,506	14,800
Gen. Cargo	—	—	1,259	—	—	1,259
TOTAL	15,147,355	16,415,122	18,658,205	16,674,868	16,114,250	215,061,770

Source: Toledo-Lucas County Port Authority 1977-1982 Annual Reports

TABLE 8

SEAPORT STATISTICS: 1976-1986, FOR SEASON THROUGH DECEMBER 31
TOLEDO HARBOR OVERSEAS CARGO (Short Tons)

Commodity	1976 Season	1977 Season	1978 Season	1979 Season	1980 Season	1981 Season
Direct Grain Shipments	11,535,384	2,128,653	2,316,088	1,630,622	1,018,702	---
Dry Bulk	24,145	74,469	480,745	111,911	---	---
Fertilizer	---	---	---	---	66,966	---
Oth. Dry Bulk	---	---	---	---	149,439	---
Gen.& Misc. Cargo	494,102 (Fac.#1)	763,895 (Fac.#1)	532,416 (Fac.#1)	441,732 (Fac.#1)	181,189	---
Coal	---	---	---	---	---	---
Petrol. Prod.	---	---	1,013	---	---	---
Liquid Bulk	24,806 (Fac.#1)	30,195 (Fac.#1)	29,025 (Fac.#1)	27,385 (Fac.#1)	30,204	---
Military Cargo	---	---	---	---	---	---
TOTAL	12,078,437	2,997,212	3,359,287	2,211,650	1,446,500	

Commodity	1982 Season	1983 Season	1984 Season	1985 Season	1986 Season	TOTAL
Direct Grain Shipments	945,220	623,178	1,143,852	1,023,168	1,224,506	23,589,373
Dry Bulk	---	---	---	---	---	691,270
Fertilizer	85,435	52,808	61,062	71,678	82,519	420,468
Oth. Dry Bulk	59,153	9,769	6,208	12,761	67,495	304,825
Gen.& Misc. Cargo	135,120	248,713	285,900	226,044	300,246	3,609,357
Coal	---	---	23,659	21,959	69,663	115,281
Petrol. Prod.	---	---	---	---	---	1,013
Liquid Bulk	30,295	36,796	15,423	34,450	55,440	314,019
Military Cargo	---	---	---	---	4,673	4,673
TOTAL	1,255,223	971,264	1,536,104	1,390,060	1,804,542	29,050,279

Source: Toledo-Lucas County Port Authority 1977-1982 Annual Reports.

RECREATION

The use of surface waters for recreation is widespread throughout the AOC. According to state studies, Lake Erie is the number one location for water recreation in the area, as it is for the state (Commission on Ohioans Outdoors, 1986; ODNR, 1980b; ODNR, 1984). In addition, the Maumee River and the Ottawa River are utilized for their recreational potential as well.

Water-based recreation activities play an important role in outdoor recreation in the AOC as does the aesthetic quality of the waters. Water based recreation is divided into two categories, contact and non-contact activity. Contact activity has been defined as any water recreation activity which results in frequent or continuous body contact with the water. Such activities would include swimming, water skiing and sail boarding. Non-contact activity has been defined as any water recreation activity which does not result in coming into frequent or continuous body contact with the water. Sailing and power boating are examples of non-contact activities.

The principle water-based recreational activities in the AOC have been sailing, canoeing, power boating, fishing, swimming, sail boarding, jet skiing, waterfowl hunting, birding, and water skiing. According to the Ohio Water Quality Standards, all of the surface waters in the AOC have a primary contact use designation. Therefore, any of these water-based recreational activities could be performed on any surface water body in the area, assuming that it was large enough to handle the activity. Due to size alone, many activities have been limited to Maumee Bay and Lake Erie, the Maumee River and the Ottawa River.

The importance of the scenic value of the area's waters should not be overlooked. Two state parks and five metroparks are directly linked to the surface waters in the AOC. The state parks are located in the eastern portion of Lucas County along the shore of Maumee Bay and Lake Erie. The metroparks are located along the Maumee River, the Ottawa River and Swan Creek.

The Toledo area, based on current and projected recreation pressure, has been identified in the Lake Erie Access Study, ODNR, as a priority area for launch ramp projects, ODNR or public agency acquisition of boat access sites and shore based fishing projects (ODNR, 1984). The public has demonstrated a strong desire to use the waters in the AOC for recreation.

Natural Areas

The Maumee River watershed in the AOC provides a great diversity of vital habitats for at least one thousand species of plants and thousands of species of animal life ranging from the white tail deer to rare insects. This variety results from landforms which range from dry sand dunes to damp prairies and swamp woodlands. It is also a corridor for migrating birds. Eagle and osprey sightings occur in the area. Over 80 plants are listed as endangered or threatened species in the State of Ohio within the AOC. The future of their existence depends directly upon improvements in water and air quality in the area.

This wildlife habitat is under the stewardship of the following organizations: The Nature Conservancy, Metropark District of the Toledo Area, various municipal parks, and several divisions of the Ohio Department of Natural Resources.

A number of research projects by the Ohio State University and the Ohio Department of Natural Resources have shown the Maumee River to be an important spawning and nursery area for many species of game and forage fishes. Large numbers of walleye from both Lake Erie and Lake St. Clair congregate in the riffles between Perrysburg and Waterville to spawn every April. This same river section is used during May by a large spawning stock of white bass. The estuarine portion of the river is used as a spawning area by gizzard shad and freshwater drum from Lake Erie and is also an important nursery area for young white bass, gizzard shad and freshwater drum. Several studies have suggested that the Maumee River may be the single most important production area on Lake Erie for gizzard shad, which are critical forage for many commercial and sport fish species.

The decline of wetland habitat in the AOC is significant historically beginning in the late 1800s and continuing up to the present. Early accounts reported vast marshes along the Lake Erie shoreline stretching for miles inland. South of the Maumee River was a wet forest called the Great Black Swamp. Large wet prairies existed south of the river and north in west central Lucas County.

These wetland habitats served as natural storage areas for rainfall, allowing water to filter through soil maintaining the water table at a higher level than it is today. Broad marshes allowed water to evaporate back into the atmosphere or to slowly flow in streams and rivers to Lake Erie. The affects of precipitation were moderated because water spread out over a large area of wet prairies, swamp forest and marshes.

With settlement came the clearing and draining of wetlands. The underlying soil was crisscrossed with drain tiles and ditches which carried the runoff to streams and rivers. With the introduction of agriculture into the area excess water needed to be quickly drained away to streams to prevent flooded crops in fields.

The natural area has been drastically altered by agriculture and development. Removal of trees and draining and filling of wetlands have reduced the time water is allowed to remain in an area.

The effect of this alteration is that more water enters streams at a faster rate carrying with it sediment. Frequent downstream flooding and increased erosion can be expected with further development. The brownish color of water in the rivers and streams of the AOC is caused by fine soil particles in suspension, resulting from erosion from agricultural run-off and developmental storm drainage sewers.

Natural areas and resources have historically provided for basic human needs and life itself. The value of preserving plants and natural areas, in general, is both for what we know about them and for what we may learn from them in future years.

Lake Erie and Maumee Bay

Water-based recreational activities on Maumee Bay and Lake Erie consist of sailing, power boating, fishing, swimming, sail boarding, jet skiing and water skiing. The primary water quality problems have been sediment and nutrient loading which increase turbidity and algae growth. Boating and fishing are probably the most important recreational activities occurring on the Lake and Bay.

Maumee Bay State Park is located along the south shore of Maumee Bay adjacent to the City of Oregon. Camping and hiking are the principle activities at the park at this time. Shoreline fishing is another recreation activity which occurs at the park. There are plans to create a beach at the park which would facilitate swimming and related activities, although some concern over the water quality in the Bay has been expressed. The problem of suspended sediments has been the primary concern.

Crane Creek State Park is located at the extreme eastern corner of Lucas County and marks the eastern most limit of the AOC. The primary recreational activities at Crane Creek State Park are swimming, boating and related activities. Activities at the park are centered around the beach. The adjacent bird trail at Magee Marsh annually attracts thousands of visitors from many states.

Maumee River

Water-based recreational activities on the Maumee River are the same as those on the Bay and include canoeing. Certain stream segments are more appropriate for one activity than another. As described under sport and commercial fishing, fishing on the River normally occurs upstream from the Maumee-Perrysburg Bridge. Sailing and power boating occur from Perrysburg to the mouth of the Maumee River, as do the other water-based activities. Canoeing is popular both upstream and downstream from the Maumee-Perrysburg Bridge, with the upstream area being the most important. The lower portion of the River (RM 7) including areas just below RM 5, at the Swan Creek confluence near Portside, is considered polluted. This also happens to be one of the areas most impacted by combined sewer overflows (CSO). Despite the pollution, people swim, ski and sailboard in this area.

The Maumee River, upstream from the Maumee-Perrysburg Bridge, is a State Resource Water and a Scenic River. The Side Cut Metropark is located in this stream segment along the banks of the Maumee River south of the City of Maumee. The principle activities at the park include canoeing, wildlife observation, hiking and fishing. Blue Grass Island can be reached from the park which is an area often used for nature exploration and is world famous for walleye fishing. The park is also an important source of historical information on the Maumee River and its impact on the development of the region.

Farnsworth Metropark is also located in this stream segment southwest of the Village of Waterville. Farnsworth is an important area for canoeing, wildlife watching and summer shore bird watching. The area around Farnsworth is important for duck hunting.

Ottawa River

Like the Maumee River, the Ottawa River is important for non-contact recreation such as sailing and power boating. Boating is mostly restricted to the area downstream from Suder Avenue due to the difficulty of getting large boats past that point. Smaller boats can make it upstream as far as Stickney Avenue and just beyond. The primary boating lanes are downstream from Suder Avenue to the Bay. The Ottawa River was one of the most important water skiing areas in the region, however, water skiing and other contact activities no longer occur to any large extent due to severe water pollution. The City of Toledo has posted the area near the Dura Landfill advising persons to avoid contact with the water, sediment and fish.

Farther upstream, the Ottawa River flows through the Wildwood Preserve Metropark north of the Village of Ottawa Hills. The major activities at the park include wildlife observation and hiking. The park also serves as an important wildlife corridor for animals such as deer.

Other recreational areas along the Ottawa River include the Ottawa Municipal Park and Camp Miakonda Boy Scout Reservation.

Swan Creek

Due to water pollution problems and the physical characteristics of Swan Creek, contact and non-contact recreational use of Swan Creek is uncommon. The upper reaches of Swan Creek however do have important aesthetic values. The Swan Creek Preserve Metropark is located in the western portion of the City of Toledo in a rapidly developing urban area. Swan Creek flows through this park and is its primary natural feature. The park is an important resource for the area not only because of its location, but also because it is probably the best example of flood plain habitat in the region.

Swan Creek also flows through the Oak Openings Preserve Metropark in western Lucas County.

Coastal and Estuarine Marshes

The Maumee Bay lies at the mouth of the Maumee River and is formed by Little Cedar Point on the east and Woodtick Peninsula on the west. These two sand spits provide the shelter necessary for wetland development on their landward side. The former lies within the Cedar Point National Wildlife Refuge (administered as part of the Ottawa National Wildlife Refuge) and the latter lies partially within the Erie State Game Area (administered by the Michigan Department of National Resources). The Cedar Point marshes extend westward along the south shore of the bay to Maumee Bay State Park. Estuarine wetlands also occur along the Maumee River valley, between Rossford and the first bedrock riffles at Perrysburg, and in the lower reaches of the Ottawa River (Herdendorf, 1987).

The marshes in the bay are protected by dikes and are managed for waterfowl. The estuarine wetlands are less disturbed wherein the water level is not controlled. At one time the Ohio shoreline of western Lake Erie in its natural state was generally a marsh area fronted by low barrier beaches. Today there are some 23 square miles of coastal and estuarine marshes remaining which are depicted in Figure 5. These eight marshes as numbered on the map are described in Table 9 (Herdendorf, 1987).

The major plant species thriving in the Maumee Bay marshes include narrow-leaf cattail, broad-leaved cattail, jewelweeds, swamp rosemallow, blue-joint grass and swamp milkweed. In the transition zone between open water and the cattail stands, soft-stem bulrush and three-square bulrush are the dominant species (Herdendorf, 1987).

TABLE 9

COASTAL AND ESTUARINE MARSHES

Map No.	Name	Ownership	Size	Water Level Control
1	Woodtick Peninsula Marsh	SC/PM	L	Diked/Uncontrolled
2	North Maumee Bay Marsh	C/PM	L	Diked/Uncontrolled
3	Ottawa River Estuary	PM	S	Uncontrolled
4	Maumee River Estuary	PM	L	Uncontrolled
5	Toledo Harbor Wetlands (spoil area)	F/M PS	S	Diked
6	Cedar Point Marsh	F	L	Diked
7	Metzger Marsh	S	S	Diked
8	Ottawa Marsh	F	L	Diked

SC = Shooting Club
PM = Private, multiple owners
F/M = Federal/Municipal
F = Federal
S = State
PS = Private, single owner
L = Over 1,235.5 Acres (500 ha)
S = Under 1,235.5 Acres (500 ha)

Source: Adapted from Herdendorf, 1987 Appendix B, The Ecology of the Coastal Marshes of Western Lake Erie: a Community Profile, Biological Report 85(7.9), Fish found in the Maumee Bay wetlands include: bowfin, carp, yellow perch, largemouth bass, white bass, green sunfish, yellow bullhead, gizzard shad and walleye (Herdendorf, 1987).

The most common waterfowl are mallard, black duck, green-winged teal, blue-winged teal, northern shoveler, and American coot. Tundra swans and snow geese also utilize the area for resting during spring migration. The historical occurrence of the rare Foster's tern has been reported for these wetlands. A bald eagle nest is active on Little Cedar Point (Herdendorf, 1987).

These wetlands are also a part of two major flyways, the Atlantic and the Mississippi (see Figure 5). Western Lake Erie marshes attract large numbers of migratory waterfowl, causing a crossing point of these two flyways, as shown on Figure 5. Basically, there are four distinctive flyways identified for North America. Each flyway has its own individual population of birds making the semiannual flights between breeding grounds and wintering grounds (Herdendorf, 1987).

Canada geese and diving ducks, including canvasbacks, redheads and scaup, come from their breeding grounds on the great northern plains of central Canada on the Atlantic flyway to winter over in the Chesapeake and Delaware Bays. The dabbling ducks such as mallards, black ducks and bluewinged teals that have gathered in southern Ontario during the fall, cross western Lake Erie and proceed southwest to the Mississippi delta and the Gulf of Mexico coasts (Herdendorf, 1987).

Coastal marshes and stream mouths commonly attract migrating dabbling ducks, with the diving ducks concentrating on the open water shorelines. Canada geese and mallards also feed heavily on waste grains in agricultural fields (Herdendorf, 1987).

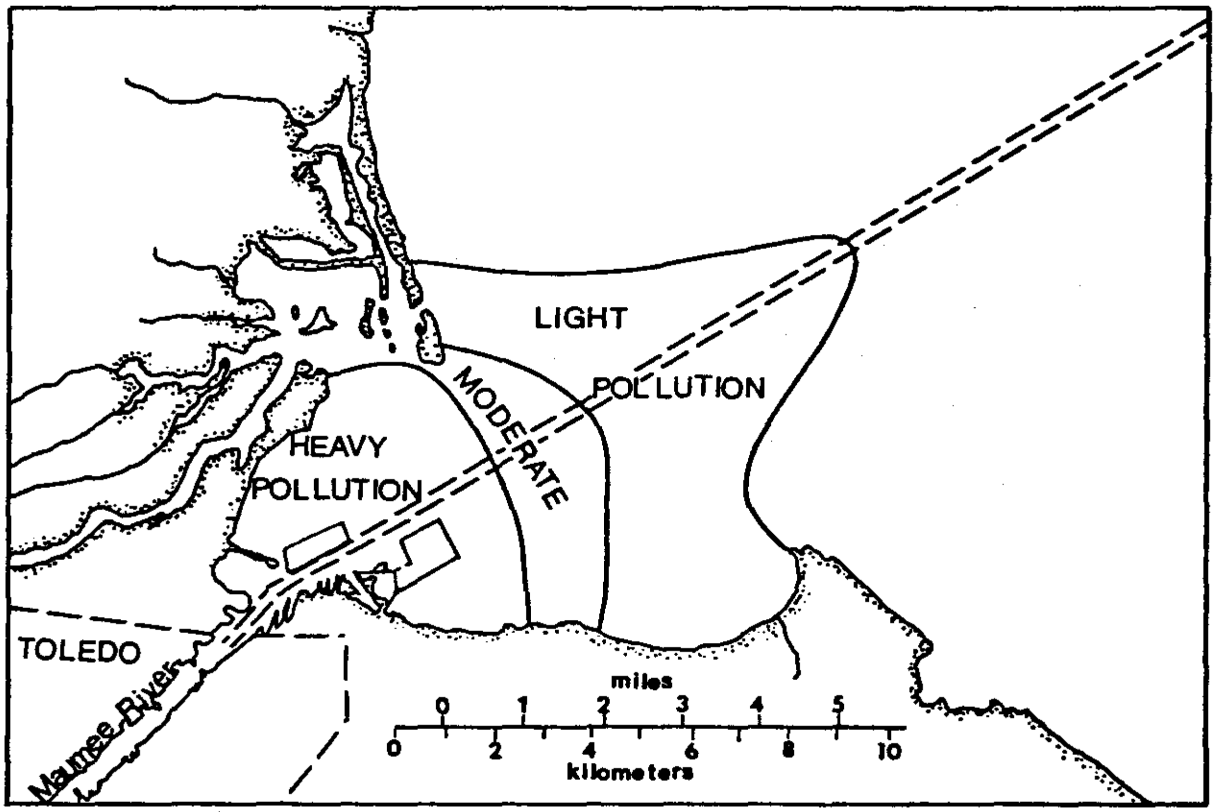
Wading birds such as herons and egrets arrive in the western Lake Erie region in early March and migrate southward in October. Upon their arrival, courtships and nest building begin immediately. They usually forage on the shorelines of the tributary streams and coastal marshes, feeding upon fish and insects (Herdendorf, 1987).

Gulls and terns also use these coastal marshes, but the ring-billed gull are becoming more common and are now known to use the Toledo-Lucas County Port Authority Facility No. 3 (dredge disposal facility). Terns also use the diked spoil areas near the Toledo Harbor. Herring gulls are also prevalent and feed on dead fish, refuse and other organic debris along the shoreline, including landfills as their food supply (Herdendorf, 1987).

The estuarine and coastal marshes of Western Lake Erie serve as sinks for many of pollutants. Maumee Bay exhibits elevated numbers of tubificid worms, an indication of high organic pollution. Note Figure 6 which displays pollution zones in the Maumee Bay as indicated by concentration of tubificids (sludge worms) in the bottom sediments. Turbidity throughout Maumee Bay and many of the estuarine and coastal marshes is high. The average concentration of suspended solids in Maumee Bay is 37 milligrams per liter (mg/l), but nearshore levels are generally over 50 mg/l (Herdendorf, 1987).

FIGURE 6

POLLUTION IN MAUMEE BAY AS INDICATED BY CONCENTRATION OF TUBIFICIDS
(SLUDGE WORMS) IN THE BOTTOM SEDIMENTS.
(WRIGHT 1955; PINSAK AND MEYER 1976).



LIGHT = 100 - 999 Tubificidae per square meter

MODERATE = 1,000 - 5,000

HEAVY = more than 5,000

Source: Maumee River Basin Level B Study.

WATER QUALITY STANDARDS

Most of the streams in the Maumee Basin RAP Area are designated as Warmwater Habitat and Agricultural Water Supply. The reaches of the Maumee in the immediate vicinity of the Bowling Green and Waterville intakes are designated as Public Water Supply. There are standards that apply for many water quality parameters depending on the stream reach's designation for aquatic life habitat, water supply, and recreational contact type. Table 10 gives the water quality standards that apply to most streams in the RAP Area. For an exhaustive listing of all water quality standards, refer to the Water Quality Standards in the Ohio Revised Code (Ohio EPA, 1990a).

TABLE 10

WATER QUALITY STANDARDS

WARMWATER HABITAT PARAMETERS

Water Quality Parameter	Average*	Maximum
Free CN, ug/l	12.	46.
DO, mg/l (minimum values)	5.0	4.0
TDS, mg/l	1500	--
Fe, total recoverable, mg/l	1.0	--
MBAS, mg/l		0.5
Cl, residual, ug/l	11.	19
Cr, hex., dissolved, ug/l	10	15
Hg, total recoverable, ug/l	0.2	1.1
Oil & Grease, mg/ll		10
Phenol, ug/l	370.	53,000
Phosphorus	(see note below)	
Polychlorinated biphenyls, (PCBs) ug/l		0.001
Ag, total recoverable, ug/l	1.3	Depends on $CaCO_3$
pH	6.5 (Minimum)	9.0 (Maximum)

STANDARDS THAT DEPEND ON HARDNESS

	@ 200 ppm AS CaC03	@.400 ppm as CaC3
Cu, total recoverable, ug/l	22	72
Ag, total recoverable, ug/l	1.3**	17
Zn, total recoverable, ug/l	190	380
Pb, total recoverable, ug/l	17	780

* 30-day average unless otherwise indicated
** Average is not hardness dependent

(continued)

TABLE 10
(continued)

WATER QUALITY STANDARDS

AGRICULTURAL WATER SUPPLY PARAMETERS

Water Quality Parameter	Average
Arsenic, As, total recoverable, ug/l	100
Beryllium, Be, total recoverable, ug/l	100
Cadmium, Cd, total recoverable, ug/l	50
Chromium, Cr, total recoverable, ug/l	100
Nickel, Ni, total recoverable, ug/l	200
Selenium, Se, total recoverable, ug/l	50

PHOSPHORUS

There is no specific water quality standard for phosphorus. Ohio's Water Quality Standards state: "Total phosphorus as P shall be limited to the extent necessary to prevent nuisance growths of algae, weeds, and slimes that result in a violation of the water quality criteria ... or, for public water supplies, that result in taste or odor problems. In areas where such nuisance growths exist, phosphorus discharges from point sources determined significant by the Ohio EPA shall not exceed a daily average of 1.0 ppm ... or such stricter requirements as may be imposed by OEPA ...". The IJC has proposed an objective of 15 mg/l for the Western Basin.

AMMONMIA (NH_3)

NH_3 water quality standards depend on the temperature of the water, its pH, and what time of year it is. Related note: No NO_3 standard is given here, but Ohio EPA requires the community to issue a drinking water warning when NO_3 level rises above 10 ppm.

	Average		Maximum
	Dec.-Feb.	March-Nov	March-Nov.
@ pH 7.0 and 25°C	--	1.6	13.0 ppm
@ pH 8.0 and 10°C	3.3	1.4	9.5 ppm
@ pH 8.0 and 25°C	--	1.0	9.1 ppm
@ pH 7.5 and 25°C	--	1.6	13.0 ppm

These are examples of average NH_3 standards. Ohio Water Quality Standards contain full information in its Table 7-3 and Table 7-6.

NITRATE AND NITRITE: (NO_3+NO_2)

For most stream reaches in the AOC, the Agricultural Water Supply standard of 100 ppm would apply. For the reaches that are used for public water supply, the standard is 10 ppm.

(continued)

TABLE 10
(continued)

WATER QUALITY STANDARDS

BACTERIAL STANDARDS

	Fecal Coliform #/100 ml Avg	Max	E. Coli #/100 ml Avg	Max
Bacterial:				
Bathing waters	200	400	126	235
Primary Contact1	1,000	2,000	126	298
Secondary Contact	---	5,000		576

SEDIMENT QUALITY GUIDELINES

Metal	Non-Elevated	Slightly Elevated	Elevated	Highly Elevated	Extreme Elevated
As	< 13	> 13	> 18	> 28	> 47
Cd	< 0.38	> 0.38	> 0.60	> 1.03	> 1.90
Cr	< 9	> 9	> 11	> 16	> 24
Cu	< 15	> 15	> 19	> 27	> 44
Fe	< 27,724	> 27,724	> 36,112	> 52,887	> 86,439
Pb	< 21	> 21	> 28	> 43	> 73
Zn	< 83	> 83	> 108	> 156	> 253

NOTE: Sediment metal guidelines are in units of are mg/kg.

Kelly and Hite, 1984.

(continued)

TABLE 10
(continued)

WATER QUALITY STANDARDS

PESTICIDES

Public Water Pesticide	Public Water Supply[a], ug/l	Aquatic Life Habitat, mg/l
Aldrin[b]	0.000074[c]	0.01
Benzene Hexachloride	--	0.1
Chlordane	0.0046[c]	0.01
Chlorophenoxy herbicides		
2,4-D	100.0	--
2,4,5-TP (Silvex)[b]	10.0	--
Ciodrin	--	0.1
Coumaphos	--	0.001
Dalapon	--	110.0
DDT[b]	0.00024[c]	0.001
Demeton	--	0.1
Diazinon	--	0.009
Dicamba	--	200.0
Dichlorvos	--	0.001
Dieldrin[b]	0.00071[c]	0.005
Diquat	--	0.5
Dursban	--	0.001
Endosulfan	0.93	0.003
Endrin	0.2	0.002
Guthion	--	0.005
Heptachlor[b]	0.00028[c]	0.001
Heptachlor Epoxide	0.1	--
Lindane	0.19[c]	0.01
Malathion	--	0.1
Methoxychlor	100.0	0.005
Mirex	--	0.001
Naled	--	0.004
Parathion	--	0.008
Phosphamidon	--	0.03
Simazine	--	10.0
TEPP	--	0.4
Toxaphene	0.0071[c]	0.005

a = Pesticides are not to exceed the concentrations in this table, or the Safe Drinking Water Act, whichever is more stringent.

b = Use has been banned.

c = For protection of human health from the potential carcinogenic effects, at a 10^6 incremental increase of cancer risk over the lifetime, due to exposure through ingestion of contaminated water and contaminated aquatic organisms.

EXISTING WATER QUALITY DATA: A SUMMARY

The TMACOG Inventory of Water Quality Monitoring Sites and Sampling Programs (TMACOG, 1988) lists a large number of sampling sites in the Maumee River Areas of Concern. The major monitoring programs are summarized below.

ONGOING MONITORING PROGRAMS

Toledo Environmental Services Division (TESD)

The most substantial body of water quality data for the Toledo area is that collected by TESD. Water is sampled and analyzed approximately monthly, resulting in nine to eleven samples per year. Parameters include conventional pollutants: BOD_5, P, NO_2, NO_3, NH_3, DO, Cl-, SS and bacterial counts.

TESD Monitoring Sites

* Maumee River:	8 stations from mouth to Waterville
Otter Creek	1 station
Delaware Creek	1 station
Grassy Creek	1 station
* Ottawa River	8 stations from Summit St. to Sylvania Ave.
Hill Ditch	1 station
* Swan Creek	4 stations from St. Clair St. to Eastgate Rd.
Heilman Ditch	1 station
* Silver Creek	1 station
* Shantee Creek	1 station

TESD data are published in six-year intervals (Moline et al, 1987) and are not reprinted in this report. Figures 7-14 summarize the 1981-1986 data. There are four sets of graphs: Swan Creek, Tenmile Creek/Ottawa River, Maumee River, and other tributaries. There are two graphs in each group. For Swan Creek (Figures 7 and 8), the graphs display the 1981-86 average nutrients (BOD_5, DO, NH_3 and P).

These data are then displayed for Ottawa River (Figures 9-10) and the Maumee River (Figures 11-12), applying the same format as used for Swan Creek. The graphs (Figures 13-14) display these same data for Otter Creek, Delaware Creek, Grassy Creek, Hill Ditch, Silver Creek, Shantee Creek and Heilman Ditch.

Figure 7: Average Nutrient Parameters
TESD DATA, 1981-1988: SWAN CREEK

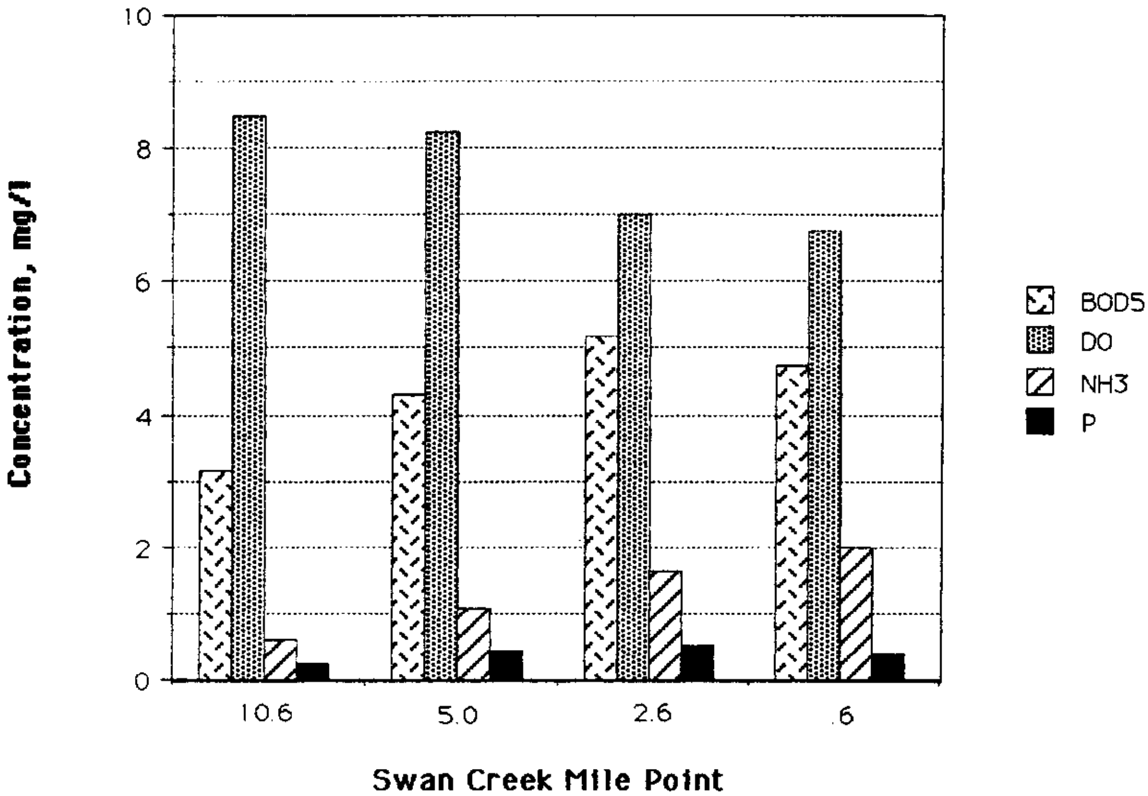


Figure 8: Average Bacteriological Parameters
TESD DATA, 1981-1988: SWAN CREEK

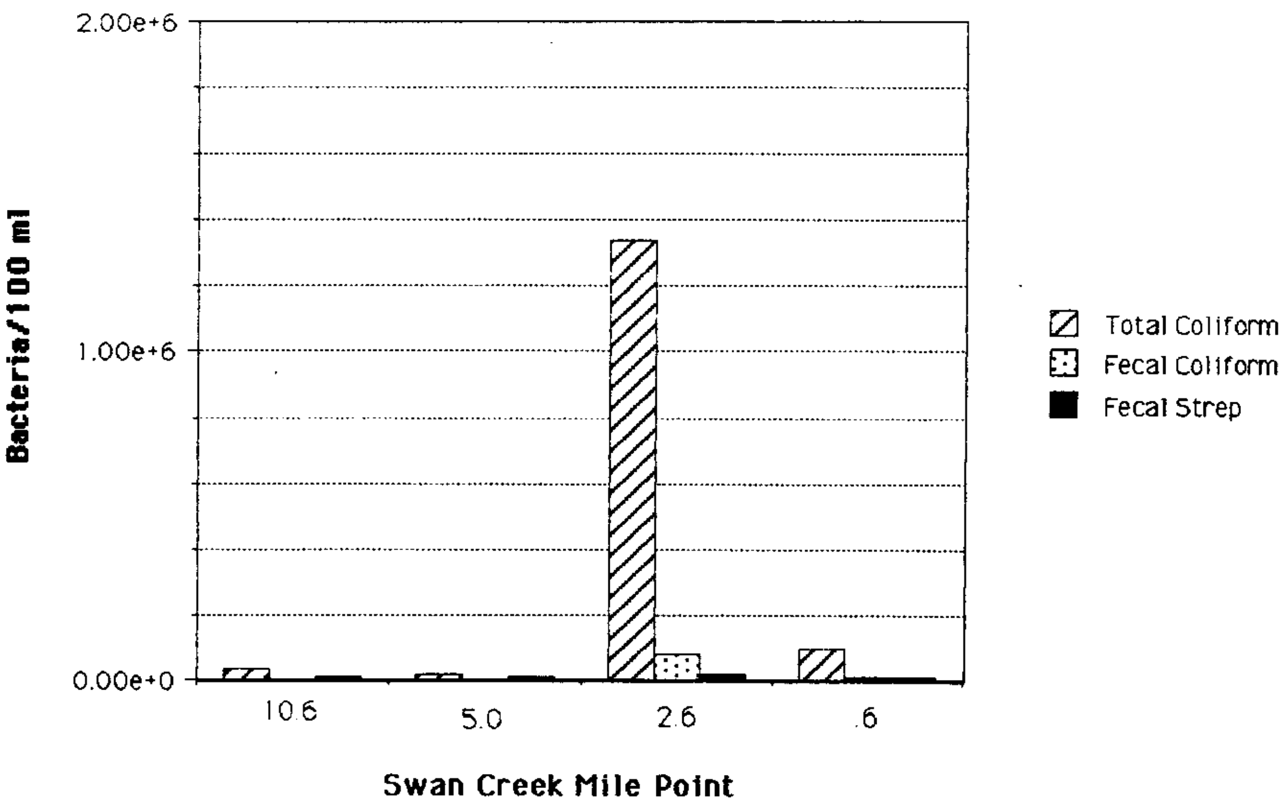


Figure 9: Average Nutrient Parameters
TESD DATA, 1981-1988: OTTAWA RIVER

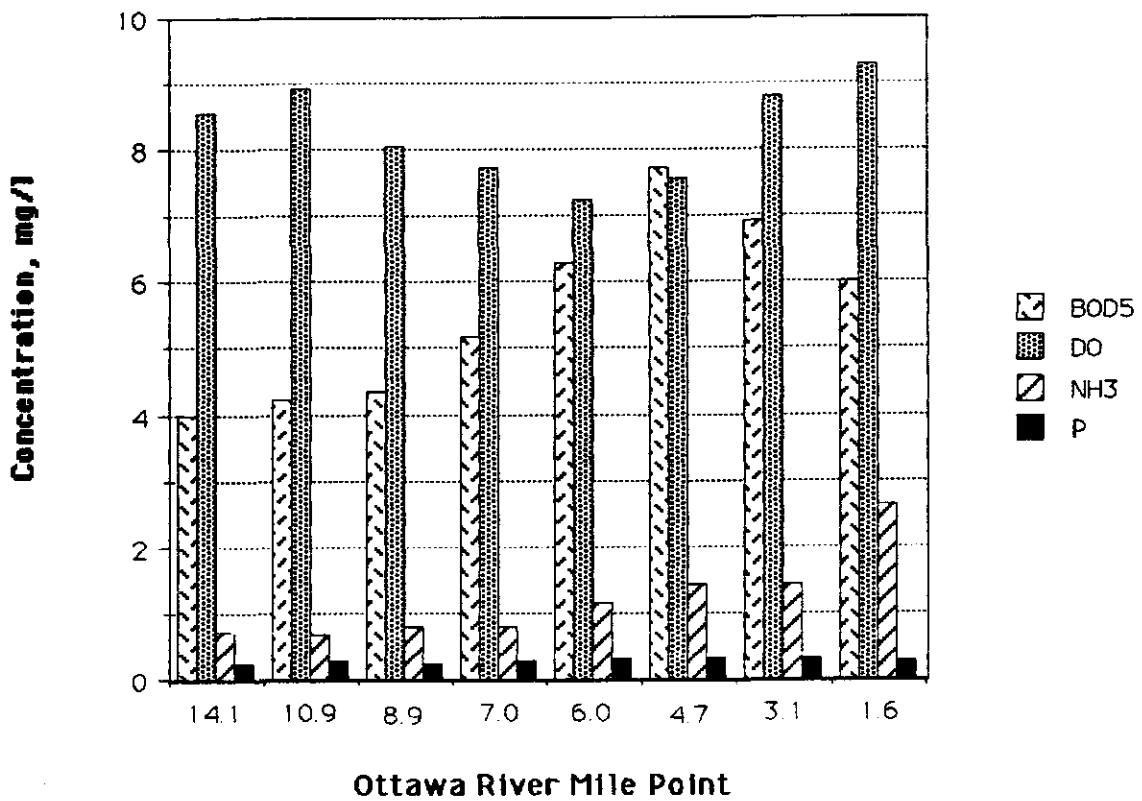


Figure 10: Average Bacteriological Parameters
TESD DATA, 1981-1988: OTTAWA RIVER

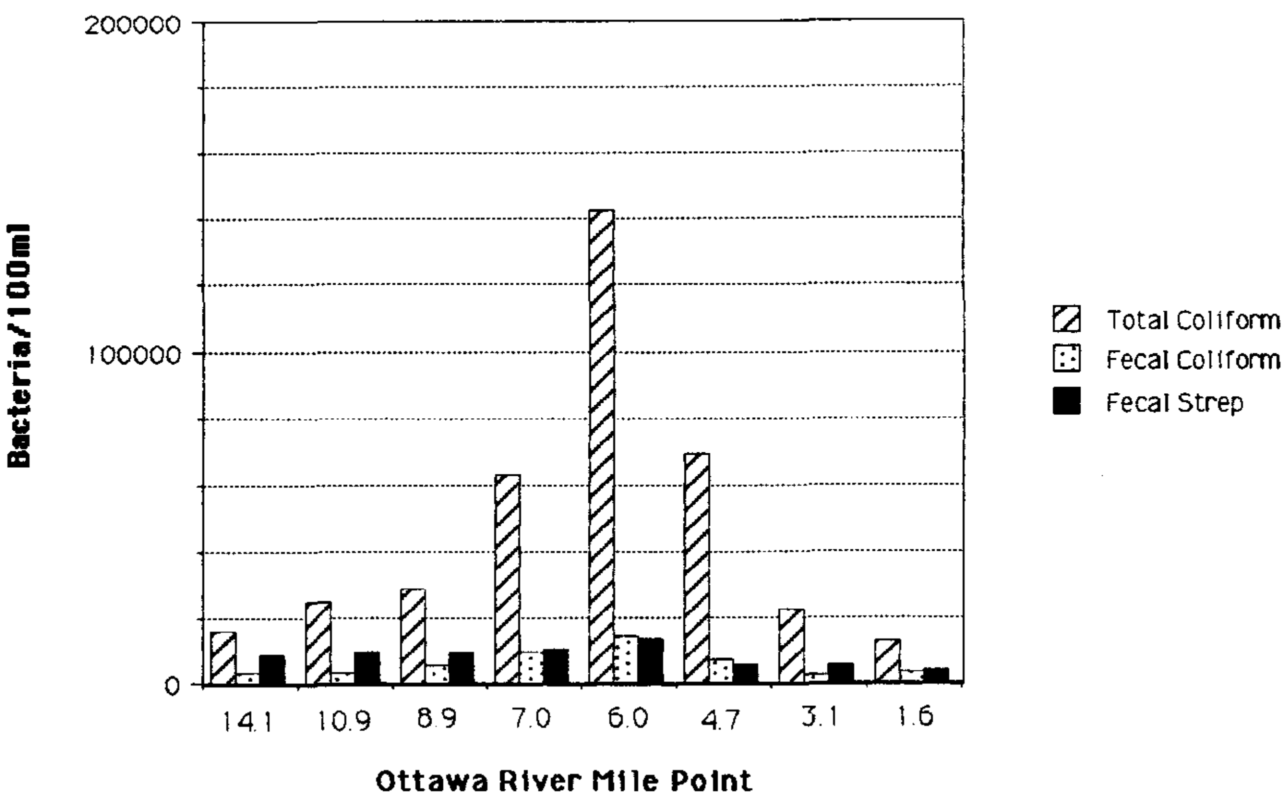


Figure 11: Average Nutrient Parameters
TESD DATA, 1981-1988: MAUMEE RIVER

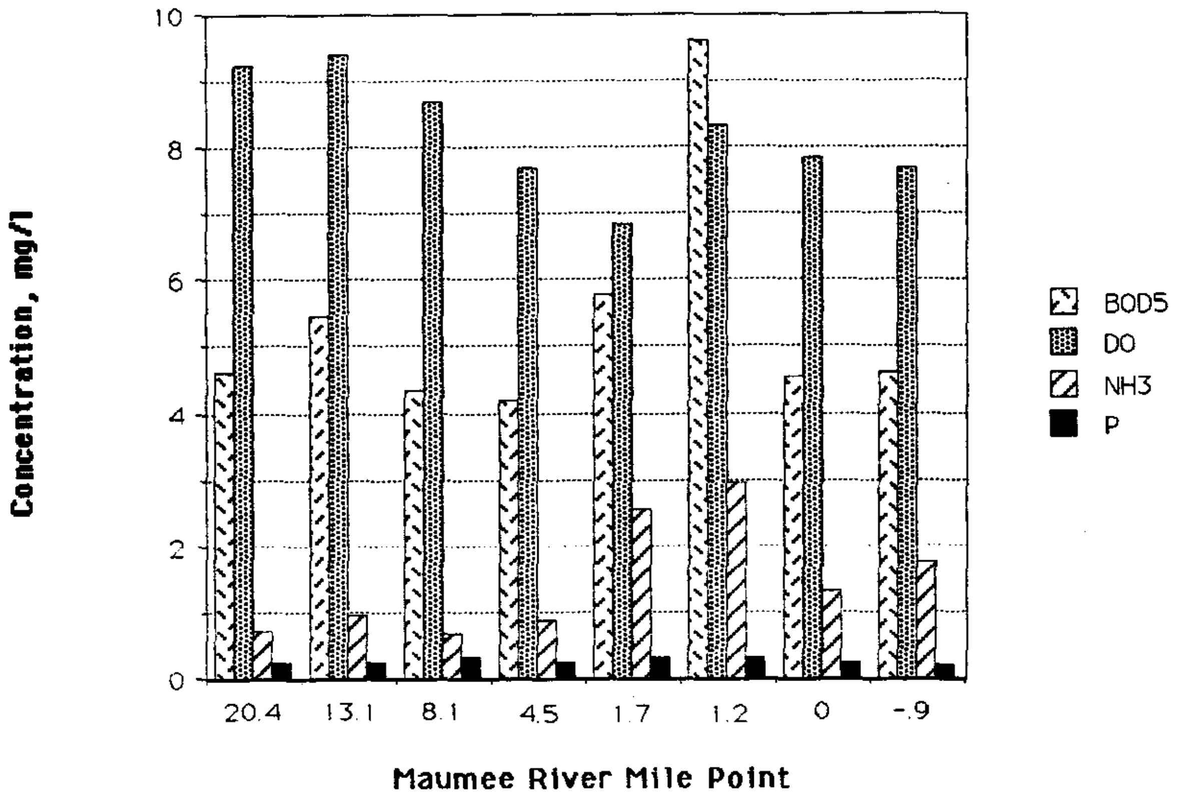


Figure 12: Average Bacteriological Parameters
TESD DATA, 1981-1988: MAUMEE RIVER

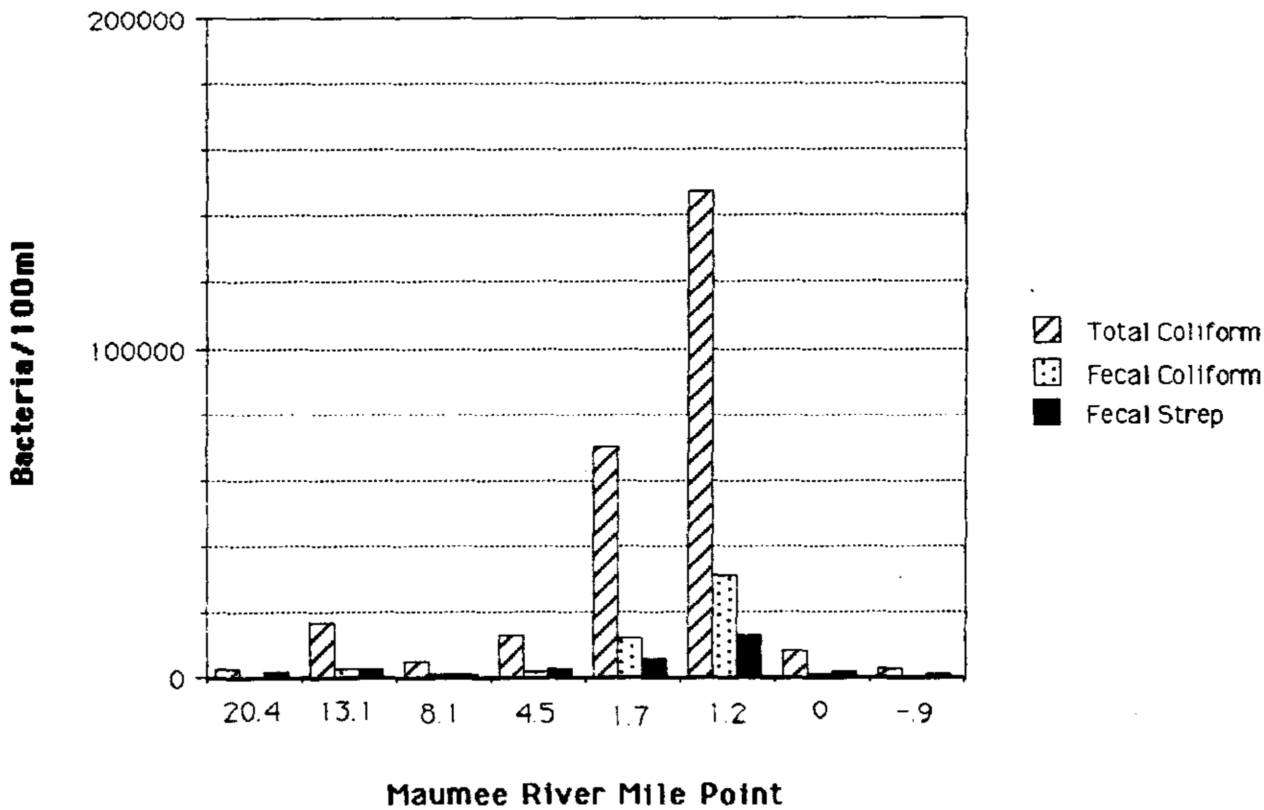


Figure 13: Average Nutrient Parameters TESD DATA, 1981-1988: Tributary Stream

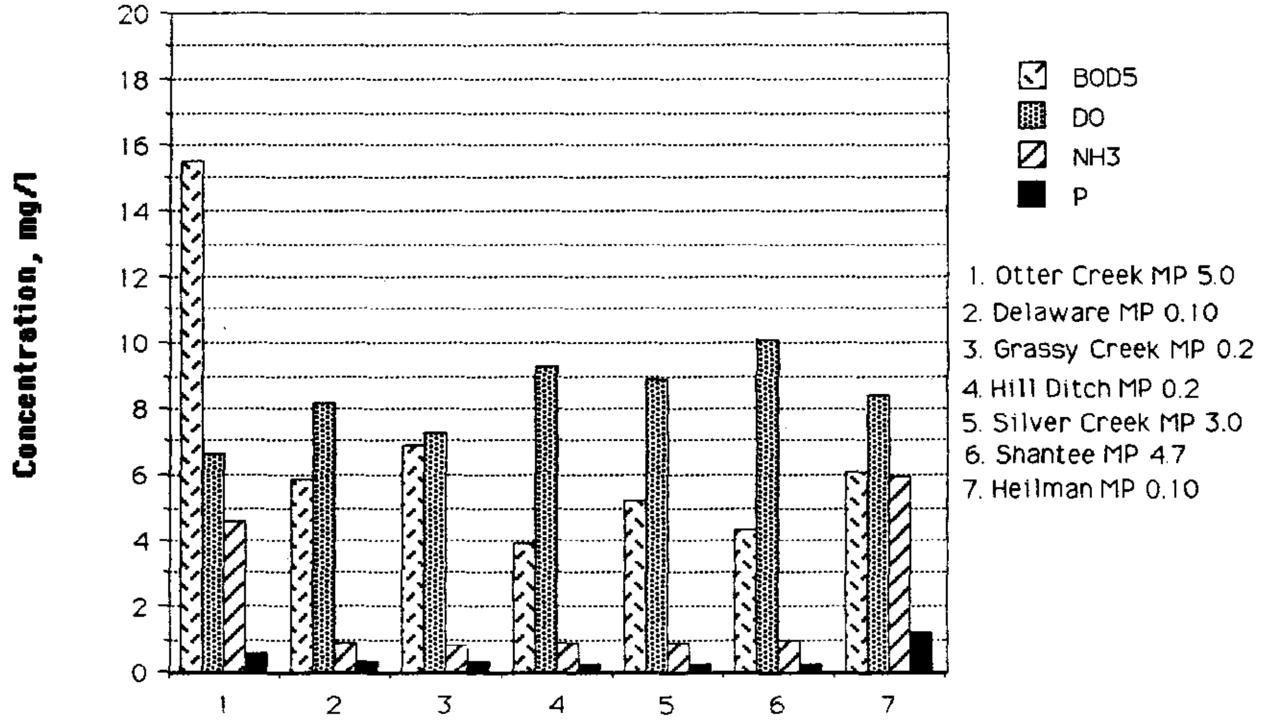
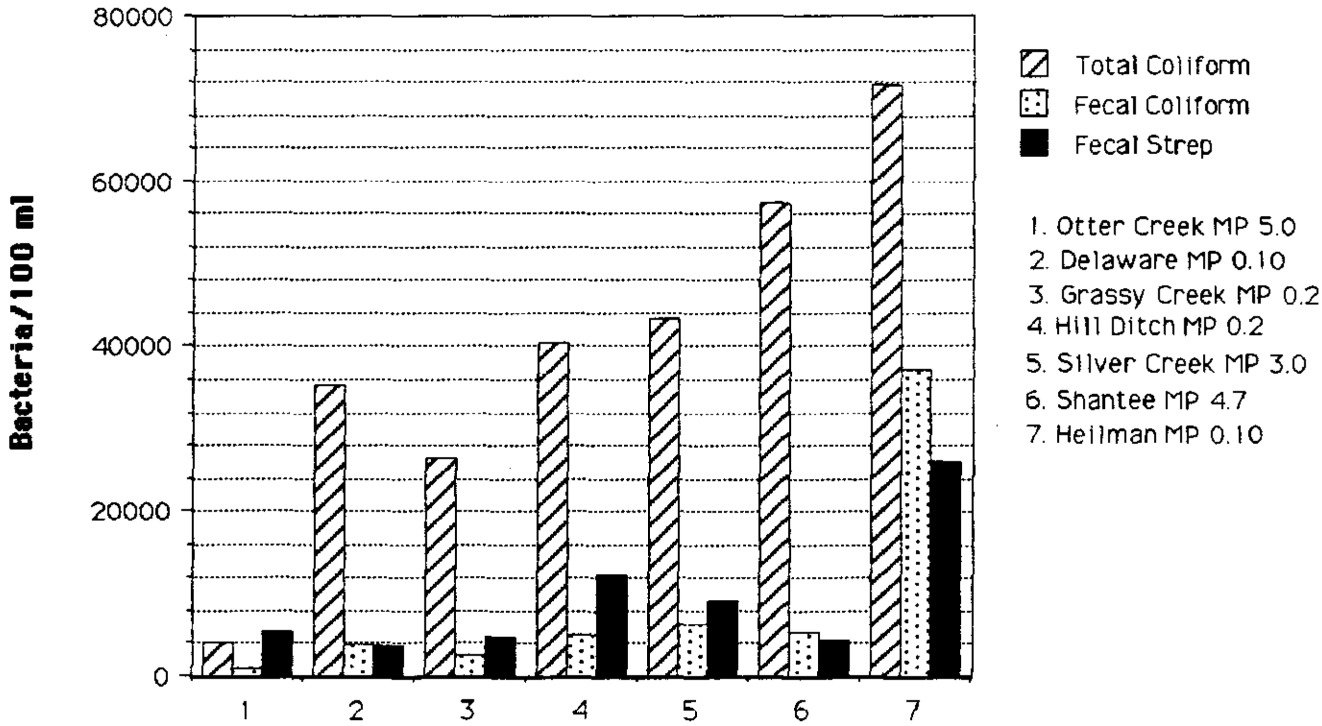


Figure 14: Average Bacteriological Parameters TESD DATA, 1981-1988 Tributary Stream



United States Geological Survey (USGS)

USGS has an on-going sampling network, although the number of sites and amount of monitoring done has decreased. Monitoring stations in the Maumee RAP Area include:

* Maumee River — Mile point 22.8 above Waterville, mile point 20.8 at Waterville and the mouth of the Maumee (discontinued 1975),

* Ottawa River — Mile point 10.8 at U.T. bridge (1977 only),

* Crane Creek — Near Curtice in Ottawa County; sampled semi-annually from 1980-82. Parameters: DO, Ca, Mg, Na, K, SO_4, Cl, F, TDS, TKN, NH_3, NO_3+NO_2, P, Fe, Mn,

* Cedar Creek — Mile point 6.9 at Curtice in Lucas County. Same monitoring details as Crane Creek site.

Only conductance, pH, temperature, and DO are sampled above Waterville. Conventional pollutants and metals (As, Ba, Cd, Cr, Cu, Fe Pb, Mn, Hg, Se, Ag, Zn) are monitored at the Waterville site; these parameters were also sampled at the two other discontinued sites.

Ohio State University Center for Lake Erie Area Research (CLEAR)

CLEAR does primarily open-lake and near-shore water quality studies. Their most intensive period of monitoring activity within the Maumee RAP Area was in 1975. Sampling that year included many sites in Maumee Bay and in the river itself as far upstream as Perrysburg (mile point 12). Sampling included conventional pollutants, and fecal coliform. It is no longer an on-going program.

Ohio EPA 305b Water Resource Inventories

Ohio EPA publishes a biannual water resource inventory describing the water quality status of the various stream reaches in Ohio. The purpose of this report is to summarize the quality of surface waters and to indicate whether they are meeting the "fishable, swimmable" criteria of the Clean Water Act (CWA). The 1990 Ohio Water Resource Inventory's assessment of aquatic life use for the lower Maumee/Ottawa River Basin is shown in Table 11. The subbasins included in this table are the Upper Middle Maumee River, the Lower Middle Maumee River, and the Lower Maumee River (and Ottawa River).

TABLE 11
1990 Aquatic Life Use Attainment

	Total Length Miles	Full	Partial	None	Not Assessed	Not Fishable
Upper Middle Maumee River	103.4	10.9	15.5	66.5	10.5	82.0
Lower Middle Maumee River	61.0	28.2	1.0	24.8	7.0	25.8
Lower Maumee River (and Ottawa River)	169.5	19.1	3.0	67.9	79.5	72.2

Source (Ohio EPA, 1990c)

The area covered by the biennial report includes the Maumee basin in Ohio which is substantially larger than the RAP Area. It includes all of Fulton, Henry, Defiance, Paulding, Putnam, Van Wert, and Allen counties, and large portions of Lucas, Wood, Hancock, Auglaize, and Mercer counties. The Ottawa River mentioned refers to the Ottawa River that flows through Lima, not the Ottawa River in Lucas County known locally as Tenmile Creek.

The 305b study summarizes the conditions of stream segments in the RAP area. These summaries are shown in Table 12 by stream reach and includes the stream designations and the Clean Water Act (CWA) use attainment. Cedar and Crane creeks, which the 305b classifies as being in the Portage River basin, were not evaluated.

TABLE 12

1990 Ohio Water Resource Inventory

STREAM	MILE POINTS	REACH	COND.	CWA	DESG
Maumee R.	14.1-37.7	Maumee-Perrysburg Bridge-Napoleon	Good	Yes	WWH
Maumee R.	7.2-14.1	Estuary reach	Fair	Part.	WWH
Maumee R.	0.0-7.2	Ship channel	Fair	Part.	WWH
Maumee Bay	-----	-----	Fair	Part.	EWH
Swan Creek	14.0-41.2	I-475 to headwaters	Fair	Part.	WWH
Swan Creek	0.0-14.0	Mouth to I-475	Poor	No	WWH

WWH = Warmwater Habitat
EWH = Exceptional Warmwater Habitat

Heidelberg College River Studies Laboratory

The Water Quality Laboratory at Heidelberg College has contributed significant research on the movement and loadings of sediment, nutrients, and more recently pesticides in the Maumee River basin. Utilizing the data available from the U.S. Geological Survey at the Waterville Survey Station and data collected by the Water Quality Laboratory (US COE, 1973), they have analyzed sediment, phosphorus, nitrogen, chlorides, and 19 different pesticides. These data provide a record of water quality conditions in the Maumee River and have been collected continuously throughout the years which allows for the development of loading data. These data have been used extensively in the Agricultural Pollution Abatement section of this report. Major reports of these data are included in several documents available from the Water Quality Laboratory (USEPA, 1983; USEPA, 1984; USEPA, 1987).

INTENSIVE OR SHORT-TERM MONITORING SURVEYS

There has been a substantial body of water quality data collected since 1970 through various one-time sampling programs.

Lower Maumee River Technical Support Document (TSD)

Ohio EPA has established five different evaluation classes for its biological criteria for determining water quality use designations and attainment of the Clean Water Act (CWA) goals. Class I (Exceptional) and Class II (Good) meets CWA goals. Class III (Fair), Class IV (Poor) and Class V (Very Poor) do not meet CWA goals. Attainment/non-attainment of aquatic life uses is determined by using biological criteria. The biological community performance measures that are used include the Index of Biotic Integrity (IBI) and the Modified Index of Well-Being (Iwb), both of which are based on fish community characteristics, and the Invertebrate Community Index (ICI) which is based on macroinvertebrate community characteristics.

An aquatic life use is fully attained if all three indices (or those available) meet the applicable criteria. Partial attainment is reached if one or more indices attain and at least one does not attain. A site is considered to be in non-attainment if all three indices (or those available) fail to meet the applicable criteria. This also applies if one of the two organism groups (fish or macroinvertebrates) indicates poor or very poor performance even if the other group is attaining the applicable criteria.

As a part of its Technical Support Document, Ohio EPA analyzed sediments for heavy metal concentrations in 1986 at eleven stations on the Maumee River (Grand Rapids Dam, Eagle Point Colony, Cherry Street Bridge and Toledo WWTP), Swan Creek (Collingwood Blvd.), Ottawa River (Lagrange Street and Stickney Avenue), Otter Creek (Oakdale Avenue, Wheeling Street, and Millard Avenue), and Duck Creek (York Street).

A summary of the biological and sediment quality data collected for the TSD is presented in Table 13. The Invertebrate Community Index (ICI) and Macroinvertebrate Densities get to the heart of measuring a stream's water quality. They indicate the ability of the stream to sustain life. High values for these indices indicate good water quality. The sediment metal data is a measure of accumulated metals at the bottom of the stream. The metals tested are toxic, so low values indicate a good environment for bottom-dwelling animals.

TABLE 13

LOWER MAUMEE RIVER TECHNICAL SUPPORT DOCUMENT

STREAM	LOCATION	RATING	BANK	MILE	ICI	DENSITY	Cd	Cr	Cu	Pb	Ni	Zn	As
							Sediment Concentration (mg/kg dry weights)						
Maumee River Subwatershed													
Maumee	Grand Rapids Dam	Good		32.1	42	1697	0.24	5.9	5.3	15.3	4.8	24.5	—
Maumee	Woodcock Island	Exceptional		25.1	52	1384	—	—	—	—	—	—	—
Maumee	SR 64	Exceptional		20.9	54	1627	—	—	—	—	—	—	—
Maumee	US 20	Marginally Good		15.0	24	544	—	—	—	—	—	—	—
Maumee	Maple St. Boat Launch	Marginally Good	S	13.6	20	405	—	—	—	—	—	—	—
Maumee	Carey St. Boat Launch	Fair	N	13.3	14	467	—	—	—	—	—	—	—
Maumee	Eagle Point			9.4	—	—	0.95	43.2	36.3	52.3	44.8	178.0	21.5
Maumee	Walbridge Park	Fair	N	8.8	18	913	—	—	—	—	—	—	—
Maumee	Libbey-Owens-Ford	Fair	S	7.3	12	688	—	—	—	—	—	—	—
Maumee	I-75	Marginally Fair	N	7.2	8	440	—	—	—	—	—	—	—
Maumee	Cherry St. Bridge	Marginally Fair	N	4.7	8	544	1.52	33.4	65.3	108.0	34.4	190.0	10.1
Maumee	Consaul St.	Fair	S	3.6	14	706	—	—	—	—	—	—	—
Maumee	Riverside Park	Marginally Fair	N	3.1	10	387	—	—	—	—	—	—	—
Maumee	Harrison Marina	Marginally Fair	N	1.5	6	579	—	—	—	—	—	—	—
Maumee	Bay View Park	Marginally Good	N	0.7	16	1166	1.46	57.2	45.5	52.5	46.2	384.0	12.9
Duck Creek	Wheeling Road	Very poor		3.0	4	145	—	—	—	—	—	—	—
Duck Creek	York Street	Poor		2.1	10	190	0.6	14.0	21.2	72.8	14.0	115.0	13.9
Duck Creek	Port Authority	Poor		0.4	10	43	—	—	—	—	—	—	—
Otter Creek	East Broadway	Fair		7.2	—	—	—	—	—	—	—	—	—
Otter Creek	Oakdale Ave.	Very poor		6.0	0	0	0.52	32.0	30.0	49.0	22.0	170.0	26.1
Otter Creek	Wheeling Road	Very poor		4.0	0	166	0.66	149.0	46.0	142.0	26.0	163.0	14.4
Otter Creek	Millard Ave.	Very poor		2.0	0	1623	0.53	54.0	71.0	68.0	19.0	129.0	7.7
Otter Creek	Mouth	Very poor		0.3	2	299	—	—	—	—	—	—	—

TABLE 13 (Continued)

LOWER MAUMEE RIVER TECHNICAL SUPPORT DOCUMENT

STREAM	LOCATION	RATING	BANK	MILE	ICI	DENSITY	Cd	Cr	Cu	Pb	Ni	Zn	As
Swan Creek Subwatershed													
Swan Creek	Eastgate Road	Fair		10.2	24	369	--	--	--	--	--	--	--
Swan Creek	Detroit Ave.	Fair		4.9	16	199	--	--	--	--	--	--	--
Swan Creek	Champion St.	Poor		3.9	8	602	--	--	--	--	--	--	--
Swan Creek	Hawley St.	Poor		2.6	6	602	--	--	--	--	--	--	--
Swan Creek	Collingwood Blvd.	Poor		1.2	8	489	1.39	27.2	18.6	165.0	29.8	285.0	13.5
Swan Creek	Mouth	Poor		0.6	12	748	--	--	--	--	--	--	--
Ottawa River Subwatershed													
Tenmile Creek	Centennial Road	Fair/marg. good		5.1	28	--	--	--	--	--	--	--	--
Tenmile Creek	Sylvania Ave.	Fair/marg. good		4.1	35	--	--	--	--	--	--	--	--
Tenmile Creek	Old Post Road	Marginally Good		1.0	36	--	--	--	--	--	--	--	--
Ottawa River	Sturbridge Road	Fair		18.5	24	382	--	--	--	--	--	--	--
Ottawa River	Centennial Hall, UT	Fair		11.0	14	297	--	--	--	--	--	--	--
Ottawa River	South Cove Blvd.	Poor		9.0	10	272	--	--	--	--	--	--	--
Ottawa River	Berdan Ave.	Poor		7.4	10	365	--	--	--	--	--	--	--
Ottawa River	Lagrange St.	Poor		6.9	10	551	1.77	72.2	71.4	195.0	53.4	333.0	1.2
Ottawa River	Stickney Ave.	Poor		4.9	8	388	0.52	23.4	87.2	116.0	21.2	124.0	4.3
Ottawa River	US 24-A	Poor		1.6	6	616	--	--	--	--	--	--	--
Lake Erie Tributaries Subwatershed													
Cedar Creek	US 20	Good		20.8	34	90	--	--	--	--	--	--	--

Ohio EPA also analyzed sediment samples from the Maumee River, Swan Creek, and the Ottawa River for a variety of volatile organic compounds. The complete sampling records are presented in Appendix A. Table 14 gives the sediment organic compound data in summary form, listing only those samples where detectable amounts of the volatile organics were found. The complete Lower Maumee River Technical Support Document is presented in Appendix G.

Cd = Cadmium
Cr = Chromium
Cu = Copper
Pb = Lead
Ni = Nickel
Zn = Zinc
As = Arsenic

TABLE 14

TSD SEDIMENTS: PRIORITY POLLUTANT DATA

CAS Number	Volatile Compound	Maumee, River Mile 9.4, Eagle Pt	Maumee, 4.9, Cherry St Conc ug/kg	Maumee, 1, WWTP Conc ug/kg	Swan, 1.2, Collingwood Conc ug/kg	Otter, 5.9, Oakdale Conc ug/kg	Otter, 4, Wheeling Conc ug/kg	Otter, 2.1, Millard Conc ug/kg	Ottawa, 6.4, Lagrange Conc ug/kg	Ottawa, 4.9, Stickney Conc ug/kg
67-64-1	Acetone		44		38	49				
108-05-4	Vinyl Acetate				39					
79-01-6	Trichloroethene				19					
108-88-3	Toluene	1300						320		
108-95-2	Phenol							890		
106-44-5	4-Methylphenol			1400				1700		
91-57-6	2-Methylnaphthalene		790							
83-32-9	Acenaphthene		1400		5300					
132-64-9	Dibenzofuran		1300		4900					
86-73-7	Fluorene		2500		7500					
85-01-8	Phenanthrene		11000	1000	29000	8700	2300		2800	4100
120-12-7	Anthracene					1900	830			
206-44-0	Fluoranthene		11000	2100	26000	12000	3500		6900	5400
129-00-0	Pyrene		7300	1900	22000	7500	3700	710		4900
85-68-7	Butylbenzylphthalate									4300
56-55-3	Benzo(a)anthracene		3900	1000	11000	5000	1800			3200
117-81-7	Bis(2-ethylhexyl) Phthalate (DEHP)	8600					650			
218-01-9	Chrysene		4000	1000	8800	3400	1700			2800
117-84-0	Di-n-octyl Phthalate			1200						3600
205-99-2	Benzo(b)Fluoranthene		1900	2000	6500	3900				
207-08-9	Benzo(k)Fluoranthene		2500	880	4400	2700				
50-32-8	Benzo(a)Pyrene		2300	990	4800	2900	1000			1800
193-39-5	Indeno(1,2,3-co)Pyrene		1500	910		2200	680			1700
53-70-3	Dibenz(a,h)Anthracene		970	890		1000				
191-24-2	Benzo(g,h,i)Perylene		1800	1100		2600	750			1800
53469-21-9	Aroctor 1242				1600					2500

Figure 15 shows the sampling sites for both TESD and Ohio EPA for the major waterways. The "square" indicates only TESD sites, the "circle" indicates both agencies, while the "triangle" indicates the sampling sites for the TSD investigative team.

U.S. Army Corps of Engineers 1983 Toledo Harbor Sediment Analyses

In 1983, Floyd Browne Associates and Aquatech, under contract from the U.S. Army Corps of Engineers (USCOE), collected and analyzed sediments from Toledo Harbor. These data collected under this project are presented in Table 15 (Floyd Brown & Associates, 1984). Included in this table are the severity ratings for various parameters when applying either the Ohio EPA guidelines or the U.S. EPA guidelines. Figure 4 has lake and river miles marked and can be referred to for Table 15 sediment sample collection locations.

TABLE 15

U.S. ARMY CORPS OF ENGINEERS, 1983-88
TOLEDO HARBOR SEDIMENT DATA

PARAMETER	Abbrev.	L-16		L-15		L-14		L-13		L-12	
		1983	1988	1983	1988	1983	1988	1983	1988	1983	1988
THERE ARE NO SEDIMENT GUIDELINES FOR THE FOLLOWING PARAMETERS:											
Tot Solids, %	TS		59.4		38.5		42.2		54.0		35.0
Phenols	Phenol		0.26		0.13		0.14		0.16		0.28
U.S. EPA HAS ESTABLISHED SEDIMENT GUIDELINES FOR THE FOLLOWING PARAMETERS:											
Vol. Solids, %	TVS		2.51		5.12		4.81		3.23		4.67
Severity			A		C		A		A		A
Mercury	Hg		0.3		0.7		0.5		0.3		0.4
Severity			A		A		A		A		A
Cyanide	CN		<.3		<.5		<.5		<.4		0.69
Severity											E
Nickel	Ni		30		49		39		32		42
Severity			C		C		C		C		C
Ammonia-N	NH3-N		21		50		42		37		93
Severity			A		A		A		A		C
Manganese	Mn		280		400		350		255		400
Severity			A		C		C		A		C
Total P	P		570		830		710		560		760
Severity			C		E		E		C		E
TKN	TKN		472		952		852		649		1,050
Severity			A		A		A		A		C
COD	COD		34,000		72,000		53,000		38,000		76,000
Severity			A		C		C		A		C
OHIO EPA HAS ESTABLISHED SEDIMENT GUIDELINES FOR THE FOLLOWING METALS:											
Cadmium	Cd		2.0		3.0		3.0		2.0		3.0
Severity			E		E		E		E		E
Arsenic	As		9		16		13		9		19
Severity			A		B		B		A		C
Chromium	Cr		32		49		38		28		37
Severity			E		E		E		E		E
Lead	Pb		40		67		45		34		59
Severity			C		D		D		C		D
Copper	Cu		32		50		39		30		44
Severity			D		E		D		D		E
Zinc	Zn		130		200		160		110		160
Severity			C		D		D		C		D
Iron	Fe		12,600		17,700		14,700		11,300		22,300
Severity			A		A		A		A		A

Except where noted, units are mg/kg.

KEY TO SEVERITY RATINGS:

	Ohio EPA Guidelines	US EPA Guidelines
A	Non-Elevated concentration	Non-Polluted
B	Slightly Elevated concentration	
C	Elevated concentration	Moderately Polluted
D	Highly Elevated concentration	
E	Extreme Elevated concentration	Heavily Polluted

TABLE 15 (Continued)

U.S. ARMY CORPS OF ENGINEERS, 1983-88
TOLEDO HARBOR SEDIMENT DATA

PARAMETER	Abbrev.	L-11 1983	L-11 1988	L-10 1983	L-10 1988	L-9 1983	L-9 1988	L-8 1983	L-8 1988	L-7 1983	L-7 1988
THERE ARE NO SEDIMENT GUIDELINES FOR THE FOLLOWING PARAMETERS:											
Tot Solids, %	TS		36.3		30.0		38.2		48.8	37.4	39.3
Phenols	Phenol		0.20		0.20		0.18		0.10	0.10	0.19
U.S. EPA HAS ESTABLISHED SEDIMENT GUIDELINES FOR THE FOLLOWING PARAMETERS:											
Vol. Solids, %	TVS		4.89		6.51		4.77		3.88	4.85	5.52
Severity			A		C		A		A	A	C
Mercury	Hg		0.3		0.3		0.3		0.2	0.3	0.1
Severity			A		A		A		A	A	A
Cyanide	CN		0.35		0.75		0.4		0.23	0.49	0.52
Severity			E		E		E		C	E	E
Nickel	Ni		38		39		28		25	38	29
Severity			C		C		C		C	C	C
Ammonia-N	NH3-N		110		170		81		59	116	120
Severity			C		C		C		A	C	C
Manganese	Mn		400		440		450		360	445	440
Severity			C		C		C		C	C	C
Total P	P		780		750		700		760	900	750
Severity			E		E		E		E	E	E
TKN	TKN		1,440		1,470		1,300		1,060	2,050	1,270
Severity			C		C		C		C	E	C
COD	COD		74,000		93,000		67,000		63,000	77,600	76,000
Severity			C		E		C		C	C	C
OHIO EPA HAS ESTABLISHED SEDIMENT GUIDELINES FOR THE FOLLOWING METALS:											
Cadmium	Cd		2.0		2.0		2.0		2.0	1.2	0.9
Severity			E		E		E		E	D	C
Arsenic	As		18		21		17		14	11.8	16
Severity			B		C		B		B	A	B
Chromium	Cr		31		30		19		21	24	18
Severity			E		E		D		D	E	D
Lead	Pb		48		38		23		33	24	25
Severity			D		C		B		C	B	B
Copper	Cu		43		41		31		29	31	28
Severity			D		D		D		D	D	D
Zinc	Zn		160		150		100		100	112	100
Severity			D		C		B		B	C	B
Iron	Fe		17,600		23,300		15,300		18,000	22,900	20,300
Severity			A		A		A		A	A	A

Except where noted, units are mg/kg.

KEY TO SEVERITY RATINGS:

	Ohio EPA Guidelines	US EPA Guidelines
A	Non-Elevated concentration	Non-Polluted
B	Slightly Elevated concentration	
C	Elevated concentration	Moderately Polluted
D	Highly Elevated concentration	
E	Extreme Elevated concentration	Heavily Polluted

TABLE 15 (Continued)

U.S. ARMY CORPS OF ENGINEERS, 1983-88
TOLEDO HARBOR SEDIMENT DATA

PARAMETER	Abbrev.	L-6		L-5		L-4		L-3		L-2	
		1983	1988	1983	1988	1983	1988	1983	1988	1983	1988
THERE ARE NO SEDIMENT GUIDELINES FOR THE FOLLOWING PARAMETERS:											
Tot Solids, %	TS	32.3	44.4	47.7	46.2	51.7	38.9	34.7	43.3	53.5	36.9
Phenols	Phenol	<0.1	0.23	<0.1	0.13	<0.1	0.20	1.4	<0.1	0.3	0.39
U.S. EPA HAS ESTABLISHED SEDIMENT GUIDELINES FOR THE FOLLOWING PARAMETERS:											
Vol. Solids, %	TVS	6.19	5.58	4.43	6.11	4.31	5.98	5.10	4.83	4.21	7.16
Severity		C	C	A	C	A	C	C	A	A	C
Mercury	Hg	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.3	0.1	0.1
Severity		A	A	A	A	A	A	A	A	A	A
Cyanide	CN	0.46	0.6	0.28	0.56	0.32	0.48	0.05	0.47	0.52	0.7
Severity		E	E	E	E	E	E	A	E	E	E
Nickel	Ni	49	25	42	23	41	27	50	24	38	30
Severity		C	C	C	C	C	C	C	C	C	C
Ammonia-N	NH3-N	205	160	192	140	146	110	169	160	133	200
Severity		E	C	C	C	C	C	C	C	C	C
Manganese	Mn	555	360	434	370	481	400	576	355	382	470
Severity		E	C	C	C	C	C	E	C	C	C
Total P	P	812	770	804	830	749	840	869	900	827	980
Severity		E	E	E	E	E	E	E	E	E	E
TKN	TKN	1,330	1,460	1,820	1,450	1,570	1,500	2,550	1,810	1,510	1,420
Severity		C	C	C	C	C	C	E	C	C	C
COD	COD	95,000	76,000	76,600	72,000	77,700	82,000	102,000	74,000	56,400	86,000
Severity		E	C	C	C	C	E	E	C	C	E
OHIO EPA HAS ESTABLISHED SEDIMENT GUIDELINES FOR THE FOLLOWING METALS:											
Cadmium	Cd	1.6	1.0	1.2	1.0	1.0	1.0	1.4	1.0	1.2	2.0
Severity		D	C	D	C	C	C	D	C	D	E
Arsenic	As	13.4	16	10.5	15	11.6	20	13.8	18	10.3	20
Severity		B	B	A	B	A	C	B	B	A	C
Chromium	Cr	31	19	24	18	22	20	30	17	23	23
Severity		E	D	E	D	D	D	E	D	D	D
Lead	Pb	26	24	25	24	20	23	27	23	19	29
Severity		B	B	B	B	A	B	B	B	A	C
Copper	Cu	40	27	35	29	35	32	43	29	30	33
Severity		D	D	D	D	D	D	D	D	D	D
Zinc	Zn	142	95	120	100	106	110	142	98	106	120
Severity		C	B	C	B	B	C	C	B	B	C
Iron		30,400	18,900	25,300	14,400	24,500	23,100	30,500	16,000	23,000	22,900
Severity	Fe	B	A	A	A	A	A	B	A	A	A

Except where noted, units are mg/kg.

KEY TO SEVERITY RATINGS:

	Ohio EPA Guidelines	US EPA Guidelines
A	Non-Elevated concentration	Non-Polluted
B	Slightly Elevated concentration	
C	Elevated concentration	Moderately Polluted
D	Highly Elevated concentration	
E	Extreme Elevated concentration	Heavily Polluted

TABLE 15 (Continued)

U.S. ARMY CORPS OF ENGINEERS, 1983-88
TOLEDO HARBOR SEDIMENT DATA

PARAMETER	Abbrev.	L-1 1983	L-1 1988	R-0 1983	R-0 1988	R-1 1983	R-1 1988	R-2 1983	R-2 1988	R-3 1983	R-3 1988
THERE ARE NO SEDIMENT GUIDELINES FOR THE FOLLOWING PARAMETERS:											
Tot Solids, %	TS	36.7	37.6	39.5	42.3	52.8	36.8	39.9	37.0	38.0	37.6
Phenols	Phenol	<0.1	0.23	0.2	0.21	0.30	0.69	1.3	0.29	<0.1	0.16
U.S. EPA HAS ESTABLISHED SEDIMENT GUIDELINES FOR THE FOLLOWING PARAMETERS:											
Vol. Solids, %	TVS	6.69	7.58	5.48	6.63	5.80	8.84	6.99	7.45	6.55	7.29
Severity		C	C	C	C	C	E	C	C	C	C
Mercury	Hg	0.2	0.1	0.3	0.2	0.2	0.4	<0.1	0.2	0.2	0.1
Severity		A	A	A	A	A	A	A	A	A	A
Cyanide	CN	0.80	1.5	2.5	0.52	1.6	1.58	1.0	0.67	0.37	0.98
Severity		E	E	E	E	E	E	E	E	E	E
Nickel	Ni	53	32	59	33	59	46	61	33	54	31
Severity		E	C	E	C	E	C	E	C	E	C
Ammonia-N	NH3-N	236	180	260	270	716	870	275	210	170	150
Severity		E	C	E	E	E	E	E	E	C	C
Manganese	Mn	580	460	504	390	467	420	482	530	491	470
Severity		E	C	E	C	C	C	C	E	C	C
Total P	P	1,050	1,100	1,470	1,200	2,120	3,500	1,340	1,400	1,210	1,100
Severity		E	E	E	E	E	E	E	E	E	E
TKN	TKN	2,410	1,870	2,540	1,700	1,630	2,620	847	1,630	1,740	2,860
Severity		E	C	E	C	C	E	A	C	C	E
COD	COD	9,5600	9,7000	9,1900	8,3000	8,4700	120,000	82,700	84,000	60,900	87,000
Severity		E	E	E	E	E	E	E	E	C	E
OHIO EPA HAS ESTABLISHED SEDIMENT GUIDELINES FOR THE FOLLOWING METALS:											
Cadmium	Cd	2.0	2.0	2.2	2.0	4.0	2.0	2.0	2.0	1.8	2.0
Severity		E	E	E	E	E	E	E	E	D	E
Arsenic	As	12.4	22	18.2	20	9.9	21	18.6	22	12.3	23
Severity		A	C	C	C	A	C	C	C	A	C
Chromium	Cr	34	24	50	31	71	57	43	39	34	24
Severity		E	E	E	E	E	E	E	E	E	E
Lead	Pb	29	26	36	34	135	52	42	29	40	32
Severity		C	B	C	C	E	D	C	C	C	C
Copper	Cu	43	37	52	38	76	52	51	39	46	36
Severity		D	D	E	D	E	E	E	D	E	D
Zinc	Zn	161	150	211	140	303	330	213	170	184	160
Severity		D	C	D	C	E	E	D	D	D	D
Iron	Fe	32,600	24,900	33,100	27,200	30,200	31,500	37,000	29,000	34,900	30,600
Severity		B	A	B	A	B	B	C	B	B	B

Except where noted, units are mg/kg.

KEY TO SEVERITY RATINGS:

	Ohio EPA Guidelines	US EPA Guidelines
A	Non-Elevated concentration	Non-Polluted
B	Slightly Elevated concentration	
C	Elevated concentration	Moderately Polluted
D	Highly Elevated concentration	
E	Extreme Elevated concentration	Heavily Polluted

TABLE 15 (Continued)

U.S. ARMY CORPS OF ENGINEERS, 1983-88
TOLEDO HARBOR SEDIMENT DATA

PARAMETER	Abbrev.	R-4 1983	R-4 1988	R-5 1983	R-5 1988	R-6 1983	R-6 1988	R-7 1983	R-7 1988
THERE ARE NO SEDIMENT GUIDELINES FOR THE FOLLOWING PARAMETERS:									
Tot Solids, %	TS	47.4	54.7	53.5	41.5	43.1	46.6	44.7	47.6
Phenols	Phenol	0.1	0.13	0.3	0.17	<0.1	0.13	<0.1	0.12
U.S. EPA HAS ESTABLISHED SEDIMENT GUIDELINES FOR THE FOLLOWING PARAMETERS:									
Vol. Solids, %	TVS	5.94	4.29	5.61	10.0	5.22	4.25	6.14	7.47
Severity		C	A	C	E	C	A	C	C
Mercury	Hg	<0.1	0.2	0.4	0.2	<0.1	0.1	0.2	0.2
Severity		A	A	A	A	A	A	A	A
Cyanide	CN	0.27	<0.3	2.1	0.5	0.92	<0.6	0.18	<0.3
Severity		E		E	E	E		E	
Nickel	Ni	57	19	47	27	51	23	48	23
Severity		E	C	C	C	E	C	E	C
Ammonia-N	NH3-N	150	88	132	150	139	91	191	89
Severity		C	C	C	C	C	C	C	C
Manganese	Mn	480	320	382	440	510	340	488	335
Severity		C	C	C	C	E	C	C	C
Total P	P	1,200	840	1,030	1,100	1,030	820	952	735
Severity		E	E	E	E	E	E	E	E
TKN	TKN	1,650	1,630	1,570	2,750	1,980	1,690	988	1,980
Severity		C	C	C	E	C	C	A	C
COD	COD	61,700	46,000	54,400	82,000	73,200	58,000	76,000	61,000
Severity		C	C	C	E	C	C	C	C
OHIO EPA HAS ESTABLISHED SEDIMENT GUIDELINES FOR THE FOLLOWING METALS:									
Cadmium	Cd	1.2	2.0	1.6	1.0	1.4	0.9	1.4	2.0
Severity		D	E	D	C	D	C	D	E
Arsenic	As	16.4	12	8.5	22	18	18	13.2	16
Severity		B	A	A	C	B	B	B	B
Chromium	Cr	29	14	26	20	26	16	28	13
Severity		E	C	E	D	E	C	E	C
Lead	Pb	37	23	55	41	28	19	22	16
Severity		C	B	D	C	B	A	B	A
Copper	Cu	53	27	46	40	39	26	38	23
Severity		E	C	E	D	D	C	D	C
Zinc	Zn	158	93	149	150	145	97	140	82
Severity		D	B	C	C	C	B	C	A
Iron	Fe	31,800	13,900	20,300	24,500	32,600	19,900	31,100	13,200
Severity		B	A	A	A	B	A	B	A

Except where noted, units are mg/kg.

KEY TO SEVERITY RATINGS:

	Ohio EPA Guidelines	US EPA Guidelines
A	Non-Elevated concentration	Non-Polluted
B	Slightly Elevated concentration	
C	Elevated concentration	Moderately Polluted
D	Highly Elevated concentration	
E	Extreme Elevated concentration	Heavily Polluted

Facilities Plans

Facilities Plans are the first step in an application for a Water Pollution Control Loan from Ohio EPA. The Water Pollution ControlLoan Fund Program used to be the Construction Grant Program. Most of the requirements are the same, such as requiring Facilities Plans. These plans include an assessment of the present situation in the study area, including water quality, and a forecast of future needs. Many Facilities Plans involved stream sampling to document water quality problems, especially septic tank discharges or other problems which new sewers or treatment plant improvements would alleviate.

Lucas County Facilities Plan

Finkbeiner, Pettis, and Strout (1983) performed water quality sampling on many streams in western Lucas County for the Lucas County Plan Update. On the smaller ditches, data collected for the Facilities Plan are still the only samples on record. The parameters tested, for the most part, were NH_3-N, BOD_5, DO, Fecal Coliform, and Fecal Strep. Data for each station include the ratio of coliform to strep which is used as a basis for determining whether bacterial contamination is due to animal wastes or human wastes. Many violations of water quality standards were noted, but will not be reiterated here. The data are available in Appendix G of the Facilities Plan. Since 1981, portions of the problem areas have been sewered, and it is probable that water quality violations in those areas have been eliminated.

Table 16 is an updated summary of this facilities plan data. The sampling points listed are:

a. Points at which water quality violations were found in 1981, and

b. Are still unsewered or are immediately downstream from unsewered areas, and

c. Indicated (in 1981) that contamination was due to human wastes.

TABLE 16

LUCAS COUNTY FACILITIES PLAN:
WATER QUALITY MONITORING FOR 1983 UPDATE

SITE NO	STREAM	APPROXIMATE LOCATION	PARAMETER VIOLATED	NOTES
Ottawa River Subwatershed				
1	Tenmile Cr.	Sylvania & Mitchaw	NH_3, FC	
2	Tenmile Cr.	Sylvania & Silica	FC	
3 *	Ottawa River	Sylvania W of Corey	FC	Bentbrook to be sewered
5 *	Tenmile Cr.	Centennial & Silica	FC	
9 *	Smith Dt .	Central & King	FC	
11	Smith Dt.	Bancroft E of McCord	FC	Subdivision upstream sewered
12*	Vanderpool Ditch	Bancroft & King	FC	
13*	Heldman Dt	Dorr & King	FC	
16*	Heldman Dt	Nebraska & McCord	NH_3, FC	Immediate area sewered
17*	Heldman Dt	McCord SE of Nebraska	NH_3, FC	Immediate area sewered
20*	Haefner Dt	Dorr & McCord	FC	
Swan Creek Subwatershed				
24*	Butler Dt	Old St Line & Irwin	FC	
28*	Butler Dt	Airport E of Crissey	NH_3, FC	
29*	Kujowski Dt	Crissey S of Airport	FC	
30	Cunningham Dt	Crissey N of Garden	FC	
31	Zaleski Dt	Eber & Salisbury	FC	
32	Wolf Cr	Albon & Airport	FC	
33	Wolf Cr	Gunn & Airport	FC	
34	Wolf Cr	Off Airport W of Holloway		
38*	Good Dt	Angola @ I-475	NH_3, FC	
39*	Butler Dt	Old St Line W of Crissey	FC	
45*	Wiregrass Dt	Soul Rd E of Wilkins	FC	
46*	Wiregrass Dt	Wilkins @ 20A	FC	

NH_3 = Ammonia
FC = Fecal coliform
* = In designated area planned for sanitary sewer service in Areawide Water Quality Management Plan

Fish kills, cited by a 1979 ODNR report, are also mentioned in the Lucas County Facilities Plan Update. They occurred in 1976 on Wolf Creek, due to a chlorine solution, and in 1976 on Swan Creek due to a municipal sewage discharge.

Additional sampling was conducted in 1985 for a Facilities Plan update (Finkbeiner, Pettis, and Strout, 1985) which was written to apply for funding to construct sanitary sewers for the Dorcas Farms and South Hill Park subdivisions in Springfield Township, northeast of Holland. As yet, these sewers have not been built, so these data, which are summarized in Table 17, may still be considered current.

TABLE 17
LUCAS COUNTY FACILITIES PLAN:
1985 MONITORING FOR DORCAS FARMS & SOUTH HILL PARK

SITE NO	1983 SITE NO	STREAM	APPROXIMATE LOCATION	SAMPLE NO	BOD_5	DO	NH_3	FC
1	38	Good Dt	Angola W of I-475,	1	164.0	1.6*	26.3*	2,600,000*
			Below S Hill Park	2	46.0	2.9*	13.9*	550,000*
				3	24.0	1.8*	7.4*	1,600,000*
				AVG	78.0	2.1*	15.8*	1,583,333*
2	n/a	Good Dt	Above Wolf Creek	1	5.4	7.8	.4	380
				2	4.8	7.4	.0	120
				3	2.1	7.2	.4	320
				AVG	4.1	7.5	.3	273
3	n/a	Wolf Cr	Below Good Ditch	1	1.4	8.4	.0	1,200
				2	2.0	8.4	.0	630
				3	1.6	8.0	.1	630
				AVG	1.7	8.3	.1	820
4	n/a	Swan Cr	Below Wolf Creek	1	1.1	8.6	.0	680
				2	1.8	7.4	.0	560
				3	1.4	8.0	.1	460
				AVG	1.4	8.0	.0	567

* = A water quality violation based on 2000 fecal coliform/100 ml, 0.5 ppm NH_3, and 5.0 ppm DO. There is no water quality standard for BOD_5, but in clean water, it should be close to 0.

Good Ditch flows through the subdivisions, and sampling site #1 is immediately downstream. Houses in the development presently use septic systems, and failures of these systems are widespread and well-documented. The sampling data clearly show pollution from untreated sewage.

Toledo Facilities Plan

The Toledo Facilities Plan was written in a number of volumes. It included separate volumes for different phases of sewerage system improvements, and there was a Combined Sewer Overflow Study (CSO) written in 1978 (Jones & Henry Engineers, Ltd., 1978), and updated in 1987.

The 1978 study included the following water quality monitoring:

1. Rainfall quantity vs. overflow quantity from various combined sewage regulators.

2. Sediments were collected at five sites along Swan Creek from the mouth to Byrne Road; and at six sites on the Maumee ranging from river mile 0 to river mile 8. Samples were analyzed for BOD_5, COD_5, P, TKN, Organic Nitrogen, NH_3, NO_2, NO_3, Oil & Grease, Fe, and Zn.

The Tenmile Creek Facilities Plan (Jones & Henry Engineers, Ltd., 1976) included similar sediment sampling at four sites on Tenmile Creek, ranging from mile point 6.2 to mile point 15.0. Parameters tested were BOD_5, COD_5, P, TKN, Organic Nitrogen, NH_3, NO_2, NO_3, Oil & Grease, Fe, and Zn.

Oregon Facilities Plan

Seven ditches and creeks were sampled for the 1974 Oregon Facilities Plan, (Finkbeiner, Pettis & Strout, 1974). Drainage areas sampled were Amlosch/Driftmeyer Ditches, Heckman Ditch, Big Ditch, Tobias Ditch and Wolf Creek. Fifteen samples were taken between 12/3/73 and 6/26/74. Parameters recorded were Conductivity, DO, BOD_5, P, Total Coliform, Fecal Coliform, Fecal Strep., Turbidity, Cl, NH_3, NO_2, and NO_3.

Additional sampling was conducted for the Harbor View Area update of the Oregon Facilities Plan (Finkbeiner, Pettis & Strout, 1974). Samples were collected at five sites, catch basins or ditches, and analyzed for DO, BOD_5, SS, P, Fecal Coliform, and Fecal Strep. One site had a DO of 4.4 ppm, and another had 5.1 ppm; the other three were under 1.5 ppm. Fecal coliform counts ranged from 25,000 to 1.1 million. BOD_5 ranged from 1.0 ppm to 148 ppm. These parameters indicated the presence of sewage.

Following thunder storms, Ohio EPA collected grab samples from seven ditches or storm sewers in July, 1981. The only parameter analyzed was fecal coliform. Two sites had counts under 100, one was 360 bacteria/100 ml, and the other four ranged from 1000 to 360,000. These samples also indicate sewage.

Luckey Facilities Plan

One grab sample was taken at each of 27 sites in local streams and ditches. Parameters analyzed were BOD_5, Fecal Coliform and DO. These samples showed the presence of sewage in the streams. The Village of Luckey presently has a combined sewerage system. The system collects dry-weather sewage flows and treats the wastewater in a lagoon WWTP, which is operated by the Village. This system was placed in operation in late 1987.

Maumee Combined Sewer Overflow Study

Maumee's combined sewer overflows were studied in detail in this report. This study is discussed in more depth in the section under CSOs.

The TMACOG 208 Program

When the Clean Water Act (PL 92-500) was originally enacted in 1972, funding was included to perform intensive water quality assessment and planning. Water quality parameters analyzed included SS, C, N, P, CODs and BODs of various durations and Fecal Coliform. One site in the Maumee Basin was monitored in 1974, and eight sites in 1975-76.

Maumee Bay Environmental Quality Studies

In 1974 and again in 1977, detailed investigations of the environmental conditions of the Maumee Bay were conducted by a team of researchers directed by Dr. Peter Fraleigh of the University of Toledo. These studies represented an examination of Maumee Bay before and after the construction of the Confined Disposal Facility (Facility #3) in Maumee Bay at the mouth of the River. The studies examined water quality, water mixing patterns, sedimentation and erosion patterns, and the biological characteristics of the Bay. Major reports of the studies are:

The Maumee Bay Environmental Quality Study 1974-Final Report, Toledo Lucas Port Authority, September 1975.

The Maumee Bay Environmental Quality Study 1977-Final Report, Toledo Lucas County Port Authority, January 1979.

WATER QUALITY DATA ANALYSIS

BOD, bacteria counts, nitrogen compounds (NO_3, NO_2, NH_3, TKN), and phosphorus compounds are "conventional pollutants" and are commonly used to test for sewage. Nitrogen and phosphorus parameters also are commonly measured to determine the effects of agricultural runoff on a stream. Most of the water quality collected in the Maumee basin consists of tests for these "conventional" pollutants.

The USGS station at Waterville provides a long history of water quality data for the Maumee River as it comes into the Toledo area. TESD data provide a similar history for water quality in the Toledo area. The TSD monitoring covered many of the same parameters, but also took a detailed look at the stream's biology and sampled sediments.

TOLEDO ENVIRONMENTAL SERVICES DATA

Discussion of TESD Data

TESD sampling includes the "conventional" pollutants: solids, phosphorus, BOD_5, nitrogen compounds, bacteria counts, conductivity, chloride, and pH. The sampling program is geared toward detecting pollution from untreated sewage. The reason for this is to record the effects of CSOs which have long been known as a major source of pollution in Toledo streams.

Trends from TESD Data

Table 18 compares the year-to-year increases and decreases in the average BOD_5, DO, NH_3, P, and fecal coliform values at the upstream and downstream stations.

TABLE 18

TESD DATA: WATER QUALITY TRENDS

	1982	1983	1984	1985	1986
Maumee River Subwatershed					
Waterville BOD_5	+	–	+	–	–
TT Bridge BOD_5	+	–	–	–	+
Waterville DO	+	–	+	–	–
TT Bridge DO	–	–	–	–	+
Waterville NH_3	+	+	x	+	x
TT Bridge NH_3	–	+	–	–	–
Waterville P	x	+	x	+	x
TT Bridge P	–	–	x	x	+
Waterville Fecal coliform	+	–	–	+	–
TT Bridge Fecal coliform	–	–	–	–	+
Swan Creek Subwatershed					
Eastgate BOD_5	–	+	+	+	+
Hawley BOD_5	–	–	+	+	
Eastgate DO	–	–	–	–	+
Hawley DO	–	–	–	–	+
Eastgate NH_3	+	+	+	+	–
Hawley NH_3	–	x	+	–	–
Eastgate P	+	+	–	–	+
Hawley P	+	–	+	+	x
Eastgate Fecal coliform	+	–	–	–	+
Hawley Fecal coliform	+	–	–	+	–
Ottawa River Subwatershed					
Sylvania Ave BOD_5	–	+	–	–	+
Lagrange BOD_5	+	–	–	–	–
Sylvania Ave DO	–	+	–	–	+
Lagrange DO	–	–	–	+	–
Sylvania Ave NH_3	+	+	+	+	–
Lagrange NH_3	+	–	+	+	–
Sylvania Ave P	–	–	+	–	x
Lagrange P	+	–	x	–	x
Sylvania Ave Fecal coliform	+	+	–	+	+
Lagrange Fecal coliform	+	–	–	–	+

KEY:

\+ = This parameter showed improvement from the previous year
\- = This parameter showed lower water quality than the previous year
x = This parameter showed little or no change from the previous year
TT = Toledo Terminal rail bridge over the Maumee River

Maumee River Subwatershed (Figures 11 and 12 on page 52)

Note: Sampling at MP (milepoint) 1.2 (NE corner WWTP) was discontinued after 1983. No samples were taken at this site in July or August 1981-83.

Bacteria Counts

The Maumee River showed a sharp peak in average bacterial counts for years 1981-1986. The peak station was MP 1.7 with an annual average count of 320,000 total coliform, and 140,000 fecal coliform.

Pollution Counts

For 1981-1986 annual averages, BOD_5 and NH_3 both peaked at MP 1.7 (6.94 ppm and 2.3 ppm, respectively). At one upstream station (MP 1.7, Toledo Terminal bridge), both parameters were notably higher than further upstream. Below MP 1.2, both parameters dropped sharply.

DO reached its lowest level (6.6 ppm) at MP 1.2, and increased to 7.0 ppm at MP 1.7. Further downstream, average DO was over 7.0 ppm.

Year-to-Year Comparisons

Upstream at Waterville, BOD_5 appears to show a general increase without any big peaks. However, in 1986 levels were lower than 1985. Near the mouth (Toledo Terminal bridge), BOD_5 shows a declining trend instead, with an especially large drop in 1984. There was an increase in 1986. DO at Waterville appears to show a slight general increase, although with a peak average DO of 10 ppm in 1984. The trend appears reversed near the mouth, with drops in DO from 1982-1985 and improvement in 1986.

At Waterville, NH_3 was low in 1981-82 and showed a marked increase in 1983 which was maintained in 1984-86. Near the mouth, NH_3 showed a general decline with a big drop in 1982. Concentrations were lower than upstream.

At Waterville, P was steady throughout the period. At the mouth, P remained fairly steady through the period although with a peak in 1986.

Bacterial counts at Waterville showed large variations with no noticeable trend. Generally all three bacterial parameters (total coliform, fecal coliform, and fecal strep) follow the same pattern, with total coliform showing the highest numbers and greatest fluctuations. In 1986, however, total coliform and fecal strep decrease at Waterville, while fecal coliform showed a sharp increase. Near the mouth, there appears to be a very clear trend. Bacterial counts showed a sharp decrease in 1982, and continued dropping in 1983-5. In 1986 there was a slight increase again.

Swan Creek (Figures 7 and 8 on page 50)

Bacteria Counts

The average July bacteria counts were less than the year-round averages for Swan Creek. The creek reaches its worst around MP 2.6 (Hawley St). At this point, the annual average total coliform was over 1.3 million. Fecal coliform counts were also high (66,000 annual average). Bacteria counts decreased below MP 2.6.

Pollution Counts

Annual average DO ranged from 8.5 ppm at MP 10.6 (Eastgate Road) down to 6.7 ppm at MP 0.6 (St. Clair St). Annual average NH_3 showed a steady increase heading downstream from MP 10.6 to MP 0.6. Average phosphorus concentrations were in the range of 0.4 to 0.5 ppm, and did not vary much from station to station.

Year-to-Year Comparisons

Upstream at Eastgate Road, BOD_5 was nearly constant from 1981-84, and showed increases in 1985 and 1986. Downstream at Hawley St, it decreased in 1982 and 1983. At Eastgate, DO decreased each year from 1981-85, and showed a marked improvement in 1986, but at Hawley the pattern was the same.

At Eastgate, NH_3 showed a constant increase from 1981-85 and dropped in 1986. At Hawley, there were small increases in 1982 and 1983 and a large one in 1984. NH_3 decreased in 1985 and 1986 overall. Phosphorus was fairly constant at both stations.

Bacteria counts showed big peaks at Eastgate in 1982 and 1983 and a smaller peak in 1985. At Hawley, there was a large peak in 1985 but counts were relatively constant the other years.

Tenmile Creek/Ottawa River (Figures 9 and 10 on page 51)

Bacteria Counts

Bacteria counts peaked at MP 6.0 (Lagrange St) and MP 4.7 (Stickney Ave). Annual average peaked at MP 6.0 with a count of around 140,000/100 ml. Fecal coliform showed less of a sharp peak.

Pollution Counts

Annual average DO ranged from 8.8 ppm at MP 10.9 (UT Bridge) dropped to 7.2 at MP 6.0, and increased back to 9.2 at MP 1.6 (Summit St). The lowest DO readings were found at MP 6.0. Below MP 3.1 (Suder Ave), DO was over 9.0 ppm. BOD_5 averaged 4-5 ppm above MP 7 (Berdan Ave) where it increased sharply. All averages below MP 7 were over 6.0 ppm.

NH_3 ranged from 0.63 ppm at MP 14.1 (Sylvania Ave) to 2.1 ppm at MP 1.6. Phosphorus remained steady at 0.2 to 0.3 ppm at all stations.

Year-to-Year Comparisons

Upstream at Sylvania Ave, BOD_5 increased in 1982-83, dropped in 1984-85 and rose again in 1986. Downstream at Lagrange Street, there was a big peak in 1982 and steady decreases in 1983-86. At Sylvania, DO showed fluctuations from year to year, but appear to be slowly decreasing over the six-year period. Lagrange showed the same pattern in DO.

NH_3 showed a general increase at Sylvania with a slight decrease in 1986. This pattern was repeated at Lagrange. Phosphorus remained constant at both stations.

Bacteria counts showed increases in 1982 and 1983, improvement the next two years, and a big peak in 1986 at Sylvania. At Lagrange, there was a big peak in 1982, then some improvement, but still had a high count the next year; more decreases in 1984-85, and a peak back to 1983 levels in 1986.

Tributaries (Figures 13 and 14 on page 53)

Bacteria Counts

The annual average fecal coliform counts for all sampling stations exceeded 1000, the average standard for Warmwater Habitat primary contact streams. Otter Creek had an average fecal coliform count of 4000/100ml, Delaware Creek had 3700/100ml, Grassy Creek had 2000/100ml, Hill Ditch had 5010/100ml, Silver Creek had 6531/100ml, Shantee Creek had 4776/100ml, and Heilman Ditch had 26266/100ml.

Pollution Counts

Otter Creek and Grassy Creek both showed high BOD_5 levels and lower DO than the other creeks. Otter Creek had an average BOD_5 of 15.1 ppm and DO averaged about 6.7 ppm. Grassy Creek BOD_5 averaged 6.7 ppm. DO averaged 7.3 ppm. The other creeks had 5.0 to 6.0 ppm BOD_5.

NH_3 was in the 0.7 to 0.8 ppm range for all creeks except Otter Creek and Heilman Ditch which averaged close to 5.0 ppm. All creeks had P concentrations in the 0.2 to 0.3 ppm range except Otter Creek (0.6 ppm) and Heilman Creek (1.1 ppm).

DISCUSSION OF LOWER MAUMEE TSD DATA

Substantially, the Maumee Basin TSD gives the same picture of water quality in area streams as do the TESD data. In general, the three major streams (Maumee River, Ottawa River and Swan Creek) have their best water quality upstream of the RAP area, continually decline until just above the mouth of the stream, and then show some improvement. The point where each of these streams is most severely degraded, according to TSD data, corresponds closely to the "worst point" shown by TESD data. This is not absolutely true for every parameter sampled, but overall, the generalization holds. For additional detail, refer to Appendix G.

TSD Sediment Samples

There are no specific standards for pollutant concentrations in stream sediments. U.S. EPA, Ohio EPA and the Ontario Ministry of Environment (MOE) offer guidelines for metals, nutrients, and PCBs, but none for the volatile organics that were found in the TSD samples of November, 1986.

Table 19 displays the results of Ohio EPA's analyses of the 1986 sediment sampling at eleven locations for seven heavy metals, when applying the U.S. EPA Sediment Quality Guidelines. Only cadmium is classed as "non-polluted" at all locations. None of these metals are considered a pollution factor upstream at the Grand Rapids Dam. As shown, the other three locations on the Maumee River are classed "heavily polluted" for arsenic, with the Cherry Street Bridge location classed as "heavily polluted" for both lead and copper, with the Toledo WWTP location classed as "heavily polluted" for zinc. Chromium, copper, lead, nickel and zinc are classed as "moderately polluted" at the remainder locations.

For Swan Creek at the Collingwood Blvd. location, lead, zinc and arsenic are classed as "heavily polluted", chromium and nickel as "moderately polluted", and copper as "non-polluted".

For the Ottawa River, classified as "heavily polluted" are copper, lead, nickel and zinc for the Lagrange Street location, with the Stickney Avenue location similarly classed for copper and lead. Arsenic is classed as "non-polluted" at both locations with chromium being classed as "non-polluted" for the Stickney Avenue location. The remaining metals for these two locations on the Ottawa River are classed as "moderately polluted".

For Otter Creek, the Wheeling Street location is classed as "heavily polluted" for chromium, lead and arsenic, with the Oakdale Avenue location similarly classed for arsenic, and Millard Avenue for copper. Copper is classed as "non-polluted" for the Oakdale Avenue and Wheeling Street locations, and arsenic being similarily classed at Millard Avenue. The remaining metals for these three locations on Otter Creek are classed as "moderately polluted".

Duck Creek at York Street is classed as "heavily polluted" for arsenic; as "moderately polluted" for zinc, lead and nickel; and as "non-polluted" for the remaining three metals.

TABLE 19

RATING OF HEAVY METALS IN SEDIMENT BY STREAM LOCATION

STREAM	LOCATION	RM	Cd	Cr	Cu	Pb	Ni	Zn	As
		(by U.S. EPA Classification)							
Maumee River Subwatershed									
Maumee	Grand Rapids Dam	32.6	NP	NP	NP	NP	NP	NP	--
Maumee	Eagle Point	9.4	NP	MP	MP	MP	MP	MP	HP
Maumee	Cherry Street	4.9	NP	MP	HP	HP	MP	MP	HP
Maumee	Toledo WWTP	1.0	NP	MP	MP	MP	MP	HP	HP
Otter Creek	Oakdale Avenue	5.9	NP	MP	NP	MP	MP	MP	HP
Otter Creek	Wheeling Street	4.0	NP	HP	MP	HP	MP	MP	HP
Otter Creek	Millard Avenue	2.1	NP	MP	HP	MP	MP	MP	MP
Duck Creek	York Street	2.1	NP	NP	NP	MP	NP	MP	HP
Swan Creek Subwatershed									
Swan Creek	Collingwood Blvd.	1.2	NP	MP	NP	HP	MP	HP	HP
Ottawa River Subwatershed									
Ottawa River	Lagrange Street	6.4	NP	MP	HP	HP	HP	HP	MP
Ottawa River	Stickney Avenue	4.9	NP	NP	HP	HP	MP	MP	MP

Key

HP = Heavily Polluted
MP = Moderately Polluted
NP = Non-polluted

Source: Table 6, Lower Maumee River TSD, Ohio EPA

TSD Fish Indices

As a part of the Technical Support Document conducted by Ohio EPA in the summer of 1986, fish species documented in the Maumee River study area reported in Trautman were compared with fish species from Ohio EPA electrofishing collections (Trautman, M.B., 1981). Trautman reported 87 different species in 1981, with Ohio EPA reporting 50, finding four new species, with 41 missing species. The four new species were: smallmouth buffalo, ghost shiner, mosquitofish, and white perch.

The Ohio EPA investigative team reported 39 species for Swan Creek compared to Trautman's 75, with three new species, totaling 36 missing species. For the Ottawa River, Trautman had reported 79 species in 1981, with the investigative team reporting 44 species, five new species, totaling 38 missing species. For Duck and Otter creeks, Trautman reported 62 species, with the investigative team reporting 25, one new species, totaling 38 missing species.

This investigative team reported the percentage of fish with external anomalies for Swan Creek. The investigation began at Eastgate Road (RM 10.2) where faunal conditions were the best, going downstream to St. Clair Street (RM 0.5). Eastgate Road is upstream from all listed permitted dischargers with results being 9.3% light blackspot, 0.6% light anchor worm, and 0.9% lesions. The Detroit Avenue station (RM 4.9), the point of the upstream lake effect on Swan Creek, results were: 3.1% light blackspot, 1.5% heavy blackspot, and 3.1% deformities. Above the Roller Dam (RM 4.4) results were: 7% light blackspot, 0.6% deformities, 1.4% eroded fins, and 0.8% lesions. At Champion Street (RM 3.9), where the combined sewers begin, results were: 0.7% light blackspot, 0.7% heavy blackspot, 1.7% light anchor worm, 0.7% deformities, 1.7% eroded fins, 2.9% lesions, and 0.7% other. At Hawley Street (RM 2.6), still in the combined sewer area, the results were: 1.5% light anchor worm, 1.5% eroded fins and 1.5% lesions. At Collingwood Blvd. (RM 1.2), the results were: 6.2% lesions and 1.8% external parasites. At St. Clair Street (RM 0.5), near the mouth where the Maumee River dilutes Swan Creek, the results were: 0.4% light anchor worm, 1.2% lesions, and 0.8% other. The investigative team reported that fish community conditions were poor in all of the areas of Swan Creek with RM 2.6 and 1.2 being very poor.

The mean fish community indices, based on electrofishing samples for both Duck Creek and Otter Creek as conducted by the investigative team, indicated Class V or very poor except for the near the mouth of Duck Creek which was poor, or Class IV.

The investigative team reported that the Maumee River upstream at RM 45.7 (downstream of Napoleon WWTP and Campbell Soup Co.) where fish community values were high (IWB=9.0, IWB2=8.7), the community composition and quality were not that exceptional. At RM 38.5 and RM 33.0 upstream of the Grand Rapids dam (RM 32.2), community values displayed a significant drop (IWB=6.9 and 6.7, IWB2=6.5 and 6.5 respectively).

The next four sites were located amongst the rapids, RMs 31.5, 26.7, 19.8 and 17.2; the community values were amongst the highest (IWB=9.2, 8.8, 9.0 and 8.6, IWB2=9.0, 8.6, 8.5 and 8.1 respectively). At RM 13.7 below the Perrysburg WWTP (RM 14.5) and at the point of the beginning of the lake effect, the community values dropped nearly a full point (IWB=7.5, IWB2=7.1). It is reported that the community values remained near this level at RMs 9.4, 7.4, 7.3 and 4.7. However, species composition did change at RM 4.7 downstream of Swan Creek. The IWB ranged from 7.8 to 7.1 while IWB2 ranged from 7.5 to 6.4.

The next five downstream stations (RMs 3.6, 3.3, 1.5 and 0.6), an area where strong seiche activities move pollution plumes both up and downstream, the IWB ranged from 7.2 and 6.4 and IWB2's ranged from 6.5 and 5.5, approximately a full point below those sites just upstream. The 1986 Ohio EPA report attributed these low community values to the upstream movement of the Toledo WWTP plume and the numerous combined sewer overflow discharges.

The report states that the Toledo WWTP also affects the Maumee Bay wherein the Maumee Bay area (0.1 Toledo Edison intake channel and 0.0 southeast of Grassy Island disposal area) displayed the lowest community values, while site 0.4 in the bay farthest from the WWTP, showed the best community values in the bay area.

Fish Tissue Sampling

Biological monitoring is a valuable tool for determining water quality because it provides a direct measure of the effects of pollutants on aquatic life. Fish tissue sampling answers the question of what pollutants, and how much, are being taken into the food chain. Fish which contain unacceptable levels of PCBs, heavy metals, or other toxics, cannot be used for human consumption. Even if people do not eat the contaminated fish, however, the toxics will stay in the food chain, and, ultimately, may find their way to the humans. Table 20 gives details of fish tissue sampling done in the Lower Maumee River from 1976 to date (Ohio EPA, 1989b).

TABLE 20

PCB CONTENT OF FISH TISSUE, LOWER MAUMEE RIVER

YEAR	SAMPLE NUMBER	SPECIES	SAMPLE TYPE	RIVER MILE	LOCATION	TOTAL PCBs (ppm)
Maumee River Subwatershed						
1985		Rock bass	W.B.C.	20.6	Waterville	0.5
1985		Carp	W.B.C.	20.6	Waterville	1.0
1985		Carp	W.B.C.	20.6	Waterville	0.2
1978		Carp	W.B.C.	20.6	Waterville	0.3
1986		Green sunfish	W.B.C.	4.6	Maumee	3.9
1986		Yellow perch	W.B.C.	0.7	Cullen Park	4.0
1986		Carp	W.B.C.	0.7	Cullen Park	6.8
1985		Carp	W.B.C.	0.7	Cullen Park	3.0
1985		Bluegill	W.B.C.	0.7	Cullen Park	1.0
1978		Carp	W.B.C.	0.7	Cullen Park	4.8
1986		White perch	W.B.C.	0.0	Maumee Mouth	7.0
1986		Channel catfish	F.	0.0	Maumee Mouth	3.8
1986		Carp	W.B.C.	0.0	Maumee Mouth	5.5
1982		Carp	W.B.C.	0.0	Maumee Mouth	11.5
1979(b)		Spottail shiner	W.B.C.	0.0	Maumee Mouth	3.3
1979(b)		Spottail shiner	W.B.C.	0.0	Maumee Mouth	2.9
1979(b)		Northern pike	W.B.	0.0	Maumee Mouth	4.9
1979(b)		Northern pike	W.B.	0.0	Maumee Mouth	4.9
1979		Carp	W.B.C.	0.0	Maumee Mouth	5.9
1979		Yellow perch	W.B.C.	0.0	Maumee Mouth	2.1
1976		Carp/Catfish	W.B.C.	0.0	Maumee Mouth	5.4
Swan Creek Subwatershed						
1986		Carp	W.B.C.	0.5	Swan Creek	5.9
Ottawa River Subwatershed						
1986		Largemouth Bass	W.B.C.	1.6	Ottawa River	12.0
1986		Carp	W.B.C.	1.6	Ottawa River	25.4
1986		Carp	W.B.C.	4.9	Stickney Ave	15.1
Tenmile Creek						
1986		Carp	W.B.C.	4.1	Tenmile Creek	6.8

a. Data rounded to the nearest tenth; W.B.C. = whole body composite sample; F = fillet sample.

b. Sample analyzed twice.

US ARMY CORPS OF ENGINEERS SEDIMENT DATA

U.S. EPA has established guidelines for sediment quality for COD, Volatile Solids, TKN, NH_3, Oil & Grease, Pb, Zn, P, Fe, As, Cd, Cr, Cu, CN, Ni, Mn, Ba, Hg, and PCBs in sediments. Ohio EPA has a set of guidelines for seven metals.

The U.S. EPA guidelines for sediment quality parameters (U.S. EPA, 1977) not covered by Ohio EPA guidelines are presented in Table 21.

TABLE 21

US EPA GUIDELINES FOR SEDIMENT QUALITY FOR GREAT LAKES HARBORS

	US EPA CLASSIFICATION		
Pollutant	Non-Polluted	Moderately Polluted	Heavily Polluted
Volatile Solids (%)	< 5	5 - 8	> 8
COD	< 40,000	40,000 - 80,000	> 80,000
TKN	< 1000	1000 - 2000	> 2000
Oil & Grease (Hexane Solubles)	< 1000	1000 - 2000	> 2000
Pb	< 40	40 - 60	> 60
Zn	< 90	90 - 200	> 200
NH_3	< 75	75 - 200	> 200
CN	< 0.1	0.1 - 0.25	> 0.25
P	< 420	420 - 650	> 650
Fe	< 17,000	17,000 - 25,000	> 25,000
Ni	< 20	20 - 50	> 50
Mn	< 300	300 - 500	> 500
As	< 3	3 - 8	> 8
Cd	---------Lower limits not established----		
Cr	< 25	25 - 75	> 75
Ba	< 20	20 - 60	> 60
Cu	< 25	25 - 50	> 50
Hg	---	---	1
Total PCB	---	---	10

All units are mg/kg dry weight unless otherwise indicated.

US Army Corps of Engineers shipping channel sediment data collected in 1983 and 1988 (see Table 15) show a serious heavy metal contamination problem. The metals of particular concern are CN, Cd, Cr, Pb, Cu, Mn and Ni. In nearly all cases, the concentrations of these parameters are highest at and slightly above the mouth of the Maumee, between R-2 and L-1.

Table 22 displays the concentration levels of metals as found in the 1983 and 1988 shipping channel sediments when applying the Ohio EPA sediment guidelines and the concentration levels of the remainder parameters for these same sediments when applying the U.S. EPA sediment guidelines.

TABLE 22

CONCENTRATION LEVELS OF METALS AND CHEMICALS IN 1983 SHIPPING CHANNEL SEDIMENTS

Metal or Chemical	Concentration Level
Arsenic (As)	Non-elevated to Elevated
Cadmium (Cd)	Elevated to Extreme Elevated
Chromium (Cr)	Highly to Extreme Elevated
Copper (Cu)	Highly to Extreme Elevated
Iron (Fe)	Non-elevated to Slightly Elevated
Lead (Pb)	Non-elevated to Elevated
Zinc (Zn)	Slightly Elevated to Highly Elevated
Cyanide (CN)	Heavily Polluted
Chemical Oxygen Demand (COD)	Moderately Polluted to Heavily Polluted
Mercury (Hg)	Non-Polluted
Manganese (Mn)	Non-Polluted to Heavily Polluted
Nickel (Ni)	Moderately Polluted to Heavily Polluted
Ammonia (NH_3)	Non-Polluted to Heavily Polluted
Phosphorus (P)	Heavily Polluted
Total Kjeldahl Nitrogen (TKN)	Non-Polluted to Heavily Polluted
Volatile Solids (VS)	Non-Polluted to Moderately Polluted

OVERVIEW OF TOXIC POLLUTANTS

This section is concerned with those chemicals which are known to biomagnify, bioaccumulate, or are suspected of causing cancer as well as those which are acutely toxic to aquatic organisms. Categories of toxic pollutants of concern, in the AOC, include polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), phthalates, and metals. Other categories of toxics which have not been studied in the Toledo area include the dioxins and furans. Studies of Toledo Harbor sediments to date have not shown sediment bound pesticides at levels high enough to arouse concern.

The Great Lakes International Surveillance Plan (GLISP), states that, "The chemical contaminants issue, especially persistent toxic substances, is the major focus of the 1978 Great Lakes Water Quality Agreement and the monitoring and surveillance plans. The effects of toxic substances on the health of the Great Lakes ecosystem, including man, are not well understood. However, some obvious problems including closed fisheries, fish morphological abnormalities, fish kills, and impairment of reproduction and deformities in aquatic birds have been well documented. Present levels of certain substances are adversely affecting growth and reproduction in some Great Lakes biota, and contaminant levels in many top predator fish still exceed the guidelines for human consumption set by public health agencies in Canada and the United States" (Lake Erie Task Force, 1986). To understand where and how these substances interact, both biotic and abiotic components of the system must be scrutinized. It is important to know the quantities and distribution of chemical contaminants and to identify the sources and fates of contaminants.

The GLISP goes on to say that "The Lake Erie Basin is the most seriously impacted of all the Great Lakes, having a total of eight Areas of Concern (including both Connecting Channels)." There is a lack of thorough quantitative pollution data bases for any of these areas (except Raisin River). "It has been documented that the most conspicuous problem found in the Areas of Concern centers around sediment contamination" (IJC, 1986b). The current knowledge and understanding of geochemical and biological processes, and their contaminated sediment problems, are limited.

Further, the 1986 Plan states that, "The Maumee River contributes over 50% of the total non-point tributary loading to Lake Erie (excluding the Detroit River). It is the most important source of agricultural nutrients and suspended sediment to the lake and particularly to the Western Basin. Records of metal and organic contaminants, as well as nutrients preserved in the sediments, measure the change in status of the lake since before the beginning of man's influence. However, due to the widespread occurrence and activity of benthic organisms in recent lake sediments and generally low sedimentation rates, annual contributions of material are mixed with older sediments so that on the average two decades of input are smeared together (Robbins, 1983). As a result of this mixing, changes in the state of the Great Lakes can be detected in the sedimentary records only on multi-decade time scales. However, in certain areas of Lake Erie sedimentation rates are so high that the time resolution may be as low as 3 to 5 years. This means that the changes in the status of Lake Erie may be more closely monitored using these areas having high sedimentation rates" (IJC, 1986b).

Nriagu and Simmons in their 1984 study found that the Total Suspended Matter (TSM) in Lake Erie (4-8 mg/l) is greater than any of the other Great Lakes. In the upper lakes 90% of the PAHs are in the dissolved phase, but in nearshore areas of Western Lake Erie a substantial fraction of the PAHs are associated with particles. Resuspension of sediments from the western basin of Lake Erie is extensive but release rates of sediment contaminants are unknown (Eadie, 1984).

Lake Erie inputs are less than the other Great Lakes except Ontario. The atmosphere is the largest source of PAH to the Great Lakes. Atmospheric inputs of benzo(a)pyrene (BaP) to Toledo area waters had been declining steadily until 1979, the last year for which there was available data (Lake Erie Task Force, 1986).

Table 23 displays Nriagu and Simmons' findings for 1982 PAH levels in Lake Erie.

TABLE 23

1982 PAH LEVELS IN LAKE ERIE

Polynuclear Aromatic Hydrocarbon	Sediment ng/g(ppb)	Atmospheric input (metric tons per year)
phenanthrene	345±92	1.5
anthracene	?	1.5
fluoranthene	569±442	?
pyrene	391±91	2.6
benzo(a)pyrene	255±52	2.5
Benzo(a)anthracene	?	1.5
Perylene	?	1.5

Source: Eadie, 1984, p 200-201

The Lake Erie Task Force (1986) found that in Lake Erie, the Western Basin sediments had the highest concentration of PCBs (660 ng/g [ppb]). This amount is twice the level of PCBs in sediments of the Central and Eastern basins of Lake Erie (Frank, et al, 1977). Nriagu and Simmons found that PCB concentrations are highest in areas of recent sedimentation and lowest in areas of scour where faster water currents prevent sediment accumulation. For Lake Erie waters, an average PCB concentration of 27 ng/l has been reported. From 1968 - 1976, the average PCB concentration in Lake Erie fish was 0.88 ug/g (ppm) with a range from 0.1 to 9.3 ug/g (Lake Erie Task Force (1986).

The 1986 Surveillance Plan states that, "Heavy metal contamination problems associated with Lake Erie have been recognized for many years. For example, mercury concentration of Lakes Erie and St. Clair from 1950 - 1970 led to a ban of commercial fishing in both systems during the early 1970's. The Lake Erie Task Force (1979), estimated loading of Cu, Pb and Zn into Lake Erie from various sources and found over 1 x 10^6 kg/yr of Cu and Pb and over 3 x 10^6 kg/yr of Zn to be retained in the lake annually. A significant portion of the load was attributed to sources originating from the Detroit River Connecting Channel System. In addition, metal contamination problems have been identified at numerous smaller tributaries entering Lake Erie's southern shore. Metal and organic contamination has led to the classification of six tributaries as Areas of Concern. As a result, the dispersion of metals into the open lake remains a concern and needs to be addressed" (IJC, 1986b).

Lead concentrations in Lake Erie sediments tend to be highest in depositional zones and least in shallow nearshore zones. One exception is the "plume" of high sediment lead concentration emanating from Toledo. Levels of lead in Lake Erie waters range from 0.46 to 3.5 ug/l. Concentrations in sediments average 154±43 mg/kg (Lake Erie Task Force, 1986).

Carbon uptake in plants is a measure of growth or photosynthesis. Munawar and Thomas (1986), found that standard elutriates of Toledo Harbor sediments caused significant inhibition of C^{14} uptake by ultraplankton (5-20 um) in algal fractionation bioassays (AFB). Such phytoplankton are abundant, have very short generation times, and are fragile and sensitive to environmental perturbations. They also are primary producers--the food source upon which the rest of the aquatic food web is ultimately dependent.

All Toledo standard elutriates caused significant inhibition of the ultra-plankton C^{14} uptake compared to the control (a reduction of 29% to 35% at a 20% elutriate concentration. (A standard elutriate was prepared by mixing one part sediment (v) with 4 parts (v) of filtered (0.45 um) lake water. This was then agitated 30 minutes by air, settled for one hour, and filtered (0.45 um). The liquid filtrate was then used in the AFB tests (Munawar and Thomas, 1986).

Mac and Willford (1986), found that Toledo Harbor sediments contained 0.210 ug/g (ppm) PCBs, most of which resembled Aroclor 1248. In a bioassay, there was no death of fathead minnows exposed to Toledo Harbor sediments and in a similar test of earthworms 36% died, although these were all in one tank in which an increase in temperature and a decrease in oxygen concentration occurred.

Preliminary review of PCBs in fathead minnows exposed to the Toledo Harbor sediments suggested a slight increase in residues during the exposure. However, the apparent increase was not statistically significant. Interpretation of the results was confounded by the finding of relatively high background levels of PCBs (pre-exposure = 4.46 ug/g) in the fathead minnows used for testing. The presence of elevated background concentrations of PCBs in the fish most likely interfered with accumulation of PCBs as compared to that noted in earthworms (Mac and Willford, 1986).

"Residues of mercury in fathead minnows showed no significant change after exposure to Toledo Harbor sediments. These results thus confirmed those results obtained with earthworms indicating no significant accumulation of mercury from Toledo Harbor sediments" (Mac and Willford, 1986).

"The bioaccumulation test is but one of several procedures available for evaluating sediments and, in dredging operations, for helping in evaluation of disposal options. The test appears to be most valuable in determining the bioavailability of contaminants present in sediments that are not considered highly contaminated or acutely toxic to aquatic organisms. When a particular sediment greatly exceeds bulk criteria for accumulable contaminants or is acutely toxic to organisms, there is little need or value in performing a bioaccumulation test" (Mac and Willford, 1986).

"Toledo Harbor sediments represent the type of materials for which bioaccumulation tests appear useful. Although the sediments contained relatively low levels of PCBs (0.21 ug/g), the earthworms accumulated 2.56 ug/g during a 10-day exposure. Even though we were unable to confirm significant accumulation of PCBs in the fathead minnows, we nevertheless believe that the test was successful in demonstrating the potential for bioaccumulation of PCBs by earthworms. The information thus should be helpful for use in selecting appropriate disposal options for dredged sediments that will protect against significant accumulation of contaminants in the tissues of organisms (Mac and Willford, 1986)."

McFarland and Peddicord (1986) studied the potential for bioaccumulation from Toledo Harbor sediments. The four organisms tested were fathead minnows, golden shiner, Japanese Medaka, and Asiatic clams. When challenged with Toledo Harbor sediments, no priority pollutants other than phthalates were detected in tissues of these organisms, and these may have been from laboratory contamination. Also, fewer than 6% mortalities occurred during bioassays on the four test species.

McFarland and Peddicord (1986) concluded that polynuclear aromatic hydrocarbons (PAH) were the compounds most likely to be bioaccumulated from Toledo Harbor sediments. Based on fluoranthene (a PAH) concentration in sediments (1.5 ppm) they calculated a thermodynamically-defined bioaccumulation potential for fluoranthene of 80.6 ppm in animal lipids. This translated to the following body burden for test animals:

Corbicula (2.4% lipid)	Medaka (9.8% lipid)	Fathead (.5% lipid)	Shiner (1.5% lipid)
1.94 ppm	7.90 ppm	4.03 ppm	1.21 ppm

No PAH were found in actual tissue. This can be explained by the fact that, unlike chlorinated hydrocarbons with similar octanol/water partition coefficients, PAHs are quickly broken down by the organisms mixed function oxidase system. Tissue residues of PAH are inversely correlated with the mixed function oxidase activity of an organism (McFarland and Peddicord, 1986)."

Chapman, et al, 1986, conducted bioassays with Toledo Harbor sediment on several organisms. "Prater-Anderson test series indicated little or no acute mortality of either Daphnia or Hexagenia exposed to the Toledo sediment system; although Hexagenia suffered 20% mortality in Toledo sediments, control mortality was 13% indicating a possible problem with organism vitality" (Chapman, et al, 1986).

In beaker tests, Daphnia mortality was 14 and 0% in freshly-prepared test systems with sediments from Toledo and Porter Lake control, respectively. However, after sitting for one week, the systems produced essentially no Daphnia mortality during the second bioassay. "One can speculate that aged samples and elutriates tend to be closer to equilibrium than unequilibrated unmixed sediment-water systems. This could be the common thread linking the results of these toxicity tests; equilibrated systems lacked the toxicity of newly-interfaced sediment and water. Would this phenomenon have occurred if we had used Toronto or Toledo Harbor water? Would these harbor waters have been toxic in their own chemistry" (Chapman, et al, 1986)? Table 24 displays the levels of organic priority pollutants found in the analyses of Toledo Harbor sediments by McFarland and Peddicord and Chapman, et al.

TABLE 24

ORGANIC PRIORITY POLLUTANTS IN TOLEDO HARBOR SEDIMENTS

	McFarland and Peddicord, 1986	Chapman, et al, 1986
	(in parts per million)	
Methylene chloride	0.036	
Dichlorobiphenyls (PCB)	0.120	
Trichlorobiphenyls (PCB)	0.220	
Tetrachlorobiphenyls (PCB)	0.680	
Pentachlorobiphenyls (PCB)	0.100	
Hexachlorobiphenyls (PCB)	0.180	
Total PCB	1.300	
BIS (2 ethylhexyl) phthalate	8.800	8.500-10.600
Acenaphthene (PAH)		0.100
Acenaphthylene (PAH)		0.062-0.065
Fluorene (PAH)		0.089.0.160
Naphthalene (PAH)		0.140-0.610
Anthracene (PAH)	0.98	0.077
Fluoranthene (PAH)	1.500	0.210-0.600
Phenanthrene (PAH)	0.980	0.480-0.610
Benzo(a)anthracene		0.670-0.730
Benzo(k)fluoranthene (PAH)		1.100-5.909
Chrysene (PAH)		1.000-5.909
Pyrene (PAH)	2.000	0.580-0.870
Benzo(ghi)perylene (PAH)		0.600
Benzo(a)pyrene (PAH)		0.600-0.770

To determine whether the concentration levels for PAHs in the Toledo Harbor sediments should be of concern, the 1983 Corps of Engineer's data results were sent to Dr. Paul Baumann, U.S. Fish & Wildlife Service. These data included the Corps station number by lake and river mile along with the concentrations for the following chemicals: Phenanthrene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(k)fluoranthene and Benzo(a)pyrene. Baumann stated in written communication that "PAH concentrations at these sites are at the lower end of the range of values for sites with cancer epizootics. However, I would consider these concentrations to pose a possible problem and to be of concern (Baumann, 1988).

Further, Baumann stated, "Since PAHs are not very soluble in water and stay in sediment close to the point source (concentrations after decline as a log function from the point source), and especially since RM 1 values are often higher than RM 2 or RM 3 values but lower than RM 4 values, it appears as if you have at least two separate point sources, one near RM 1 and one near RM 4. With additional sampling and some checking of what industries have outfalls in these areas (any coke plants associated with steel companies?), you should be able to track down the sources" (Baumann, 1988).

Table 25 lists only those chemicals that were detected in Toledo Harbor sediments by the Corps of Engineers. It also gives the river or lake monitoring station at which the chemical was detected and the concentration found.

TABLE 25

TOLEDO HARBOR CHEMICAL SEDIMENT ANALYSES
US ARMY CORPS OF ENGINEERS DATA
(mg/kg dry wt. basis)

	L-16		L-15		L-14		L-13		L-12	
Parameter	1983	1988	1983	1988	1983	1988	1983	1988	1983	1988
Acenaphthene	--	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--	--
Benzo (a) Anthracene	--	--	--	--	--	--	--	--	--	--
Benzo(a) Pyrene	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyhexyl) Phthalate	--	--	--	0.93	--	--	--	0.60	--	--
Chrysene	--	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	0.16	--	--	--	--
Pyrene	--	--	--	0.24	--	--	--	--	--	--
Di-n-octyl Phthalate	--	--	--	--	--	--	--	--	--	--

TABLE 25 (Continued)

TOLEDO HARBOR CHEMICAL SEDIMENT ANALYSES
US ARMY CORPS OF ENGINEERS DATA

Parameter	L-11 1983	L-11 1988	L-10 1983	L-10 1988	L-9 1983	L-9 1988	L-8 1983	L-8 1988	L-7 1983	L-7 1988
Acenaphthene	--	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--	--
Benzo (a) Anthracene	--	--	--	--	--	--	--	--	--	--
Benzo(a) Pyrene	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyhexyl) Phthalate	--	--	--	--	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	0.14	--	0.12	--	--	--	0.22	--	0.15
Pyrene	--	0.42	--	-.28	--	0.41	--	0.52	--	0.53
Di-n-octyl Phthalate	--	--	--	--	--	--	--	--	--	--

TABLE 25 (Continued)

TOLEDO HARBOR CHEMICAL SEDIMENT ANALYSES
US ARMY CORPS OF ENGINEERS DATA

	L-6		L-5		L-4		L-3		L-2	
Parameter	1983	1988	1983	1988	1983	1988	1983	1988	1983	1988
Acenaphthene	--	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--	--
Benzo (a) Anthracene	--	--	--	--	--	--	--	--	--	--
Benzo(a) Pyrene	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyhexyl) Phthalate	--	1.09	--	1.20	--	0.78	0.24	2.09	0.23	--
Chrysene	--	--	--	--	--	--	--	0.38	--	--
Fluoranthene	--	--	--	--	--	--	--	0.40	00	0.46
Naphthalene	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	0.13	--	0.25	--	0.19	--	0.38	--	0.53
Pyrene	--	0.31	--	0.48	--	0.38	--	1.06	--	0.85
Di-n-octyl Phthalate	--	--	--	--	--	--	--	--	--	--

TABLE 25 (Continued)

TOLEDO HARBOR CHEMICAL SEDIMENT ANALYSES
US ARMY CORPS OF ENGINEERS DATA

	L-1		R-0		R-1		R-2		R-3	
Parameter	1983	1988	1983	1988	1983	1988	1983	1988	1983	1988
Acenaphthene	--	--	--	--	--	--	--	0.39	--	--
Anthracene	--	--	--	0.12	--	--	--	0.47	--	--
Benzo (a) Anthracene	--	--	--	--	--	--	--	1.21	--	--
Benzo(a) Pyrene	--	--	--	--	0.74	--	--	0.65	--	--
Bis(2-ethyhexyl) Phthalate	0.41	1.76	1.69	3.05	0.22	17.8	1.20	3.82	0.49	2.34
Chrysene	--	1.05	--	--	--	1.67	--	1.45	--	--
Fluoranthene	--	0.41	--	--	2.70	--	0.25	0.71	--	--
Naphthalene	--	--	--	0.65	--	0.57	--	0.61	--	--
Phenanthrene	--	0.67	--	0.77	0.15	1.57	0.17	2.99	0.10	0.81
Pyrene	--	0.98	--	1.20	1.24	2.44	--	2.24	--	1.50
Di-n-octyl Phthalate	--	--	--	--	--	1.79	--	--	--	--

TABLE 25 (Continued)

TOLEDO HARBOR CHEMICAL SEDIMENT ANALYSES
US ARMY CORPS OF ENGINEERS DATA

Parameter	R-4		R-5		R-6		R-7	
	1983	1988	1983	1988	1983	1988	1983	1988
Acenaphthene	--	--	--	--	--	--	--	--
Anthracene	0.10	--	--	--	--	--	--	--
Benzo (a) Anthracene	1.01	--	--	--	--	--	--	--
Benzo(a) Pyrene	0.62	--	--	--	--	--	--	--
Bis(2-ethyhexyl) Phthalate	1.50	--	0.94	1.88	0.48	--	--	0.83
Chrysene	1.43	--	--	1.27	--	--	--	--
Fluoranthene	3.03	--	0.79	1.96	0.26	0.75	--	0.33
Naphthalene	--	--	--	--	--	--	--	--
Phenanthrene	1.45	0.85	0.35	1.53	--	0.44	--	0.26
Pyrene	2.24	1.98	0.62	2.40	0.20	0.78	--	0.36
Di-n-octyl Phthalate	--	--	--	--	--	--	--	--

Table 26 displays a comparison of the analytic results of these four studies of the Toledo Harbor sediments with the Great Lakes International Surveillance Plan, 1986, analysis of heavy metals on Western Basin sediments. Cyanide and PCB levels, where available, are also included in the table.

TABLE 26

COMPARISON OF TOLEDO HARBOR AND WESTERN BASIN SEDIMENTS

	Western Basin Background Levels GLWQB Nriagu, et al, 1979	Toledo Harbor Munawar & Thomas 1986	Toledo Harbor Chapman, et al 1986	Toledo Harbor McFarland & Peddicord 1986	Toledo Harbor Mac & Willford 1986
			(In Parts Per Million)		
Hg	0.1	0.130-0.625	-	0.63	0.314
Pb	28.0	49.0-88.0	62.0	65.0	-
Zn	70.0	166.0-285.0	23.0	220.0	-
Cu	30.0	34.0-55.0	47.0	50.0	-
Cd	2.0	-	4.0	2.8	-
Mn	600.0	-	-	-	-
As	N/A	11.0-17.0	-	-	-
Cr	N/A	117.0-177.0	100.0	57.0	-
Ni	N/A	30.0-36.0	83.0	48.0	-
Cyanide	N/A	-	-	2.7	-
PCB	N/A	0.279-0.678	-	-	0.210

One of the problems with the existing sediment data in Toledo Harbor is that most of it comes from areas of the harbor that are periodically dredged by the Corps of Engineers. The need exists to sample the harbor and tributaries in a uniform manner covering areas previously unsampled for priority pollutants. Sampling should be thorough enough to allow plotting isopleths. Tributaries to Toledo Harbor which are likely sources of priority pollutants such as the Maumee River, Ottawa River, and Otter Creek should also be sampled.

Unfortunately, nationwide sediment quality criteria currently do not exist. It is our understanding that USEPA at the national level is developing national sediment quality criteria, but a final document is 1-3 years away. However, some preliminary attempts at criteria development have been completed. The EPA has developed guidelines for the pollution classification of Great Lakes harbor sediments for evaluation of dredged material disposal. As part of EPA's evaluation process for the development of sediment criteria, a paper entitled "A Discussion of PCB Target Levels in Aquatic Sediments" has been prepared by Mr. Jay Field of the Ocean Assessments Division, National Oceanic and Atmospheric Administration. The conclusion in this paper is that although toxic effects may occur at lower levels, a sediment concentration of 0.1 ppm PCBs appears to be a reasonable preliminary target level for use in assessing environmental hazards from PCB contamination and the need for remedial action. This compares to an average value of 0.21 to 1.3 ppm for the area of Maumee Bay dredged for navigation. Although national sediment quality criteria have not been completed, it appears that the sediments of the AOC are of concern and may be above future criteria levels.

Summary of Toxic Pollutants

1. Toxic substances have caused injuries to Lake Erie. There is at the present time a health advisory against eating carp or channel catfish from Lake Erie due to high PCB levels (over 2 ppm) in their flesh.

2. Sediment contamination is the most conspicuous problem in all the AOCs. There is a lack of thorough quantitative pollution data for the Toledo AOC.

3. A larger portion of Lake Erie PAHs are associated with particles than any of the other Great Lakes. Sediments in the Western Basin of Lake Erie have twice the PCB levels of the Central Basin and Eastern Basin. Contaminant release rates from resuspended sediments are unknown.

4. Some of Lake Erie's metal pollution originates on Lake Erie's southern shore. A "plume" of high sediment lead levels emanates from Toledo.

5. Chapman (1986) speculated that equilibrated sediment/water systems are less toxic than newly interfaced sediment and water. This has direct bearing on the effects of dredging and other disturbances of bottom sediments. Further study could be required.

6. Laboratory studies by Munawar and Thomas (1986) indicate that Toledo sediment elutriate caused up to 35% reduction in algae growth when diluted to 20% of its original strength.

7. Mac and Willford (1986) demonstrated that earthworms accumulated PCBs from Toledo Harbor sediments. The AOCs contribution to Lake Erie's PCB pollution problem requires further study and quantification.

8. Most of the data here reviewed comes from the navigation channel and may not adequately reflect pollutants in other parts of the AOC.

RAP AREA WATER QUALITY: OVERVIEW & CONCLUSIONS

The Lower Maumee River TSD (Ohio EPA, 1989b) provides a clear summary of how good or bad the water quality is at many points along each major stream. Each segment is rated for its water quality, and the sampling points range from "very poor" to "excellent."

The TSD gives a clear picture of water quality along Swan Creek, the Ottawa River and the Maumee River. In all three cases, water is cleanest far upstream. The Maumee River upstream water quality (the Napoleon area around river mile 50) was excellent, Tenmile Creek upstream water quality was fair to marginally good and Swan Creek was rated as fair. The streams get progressively worse as they approach and enter Toledo. All three show some recovery near their mouths, which may be due to the occasional inflow of relatively high quality water from Lake Erie.

The data provided by other sampling programs support the Technical Support Document's conclusions. The TESD data provide substantially the same picture of water quality, and the US Army Corps of Engineers' sediment data point to the same problem areas along the major streams.

One of the things the TSD data misses is the seasonally high concentration of NO_3 in the Maumee River which occurs in the spring and fall. However, the TSD was not designed to measure seasonality. NO_3 in the Maumee River at these times of year often makes the water unacceptable as a public water supply source.

The USGS/Heidelberg University data collected at the Waterville station on the Maumee River provide a record of water quality as it enters the RAP Area. They include a substantial body of information on water quality parameters associated with agricultural runoff which are not monitored anywhere else in the RAP Area.

The majority of other studies are focused on documenting specific known water quality problems. The Facilities Plans, for example, provide information on CSO problems, malfunctioning package plants, and failed septic systems. They are especially useful in determining severe effects of untreated sewage on small streams. In terms of the greater Lake Erie Basin, these problems are not significant but do pose a serious health threat, and are disastrous to the water quality of local streams.

In addition, the Invertebrate Community Indices, fish tissue data, and sediment analyses show violations of the "swimmable-fishable" goals of the Clean Water Act for the tributaries to the Maumee Bay. Further, due to toxic pollutants, there is the inability to meet the specific objectives of the Great Lakes Water Quality Agreement for these lower stream reaches.

Aquatic life use attainment for the Maumee River becomes non-attainment at RM 9.4 and persists all the way into Maumee Bay. The fish species investigation in 1986 for both the Maumee River and Swan Creek show a 50% decline since 1981. The fish community composite and quality values drop 2 points on the Maumee River from upstream at the Grand Rapids dam to the Swan Creek confluence. From there these values drop another point to the mouth.

PAHs and phthalates have been found at detectable levels in the Maumee River shipping channel sediments, wherein the PAH concentrations could pose a possible problem and must be of concern. Studies of the Toledo Harbor sediments have not shown sediment-bound pesticides at levels high enough to arouse concern. Dioxins and furans have not been studied.

Impacting water quality on the Ottawa River are the dumps which leak conventional and organic priority pollutants. The degradation of Otter Creek is directly related to arsenic leaking from settling ponds, with oil soaked banks, and nickel and cyanide being detected in its waters.

In terms of the greater Lake Erie Basin, phosphorus is considered the critical nutrient contributing to eutrophication. Ohio EPA's Phosphorus Reduction Strategy for the Lake Erie Basin states that a total loading reduction of 1,365 tons P/year needs to be achieved (Ohio EPA, 1985). The Maumee basin is one of the major sources of phosphorus loading in the Lake Erie Basin. Total phosphorus loadings to the Lake Erie Basin from various sources in the RAP Area are estimated and displayed in Table 27.

TABLE 27

TOTAL PHOSPHORUS LOADINGS FROM RAP AREA SOURCES

PHOSPHORUS SOURCE	ESTIMATED LOADING (Tons P/year)
Agricultural Runoff	1197
POTWs	189
Urban Runoff	21
Package Plants	9
CSOs	Insufficient data
Industrial Wastewater	Refer to Appendix I
Home Sewage Disposal	Insufficient data
Landfills & Dumpsites	Insufficient data
Atmospheric Deposition	Insufficient data
TOTAL:	1416

WATER POLLUTION SOURCES

INDUSTRIAL WASTEWATER DISCHARGES

Industrial wastewater dischargers cover a broad range of types of facilities. Examples include treated chemical discharges from plating operations, cooling water from power generating stations, quarry dewatering from crushed stone producers, lime sludge from municipal water treatment plants, and treated process wastes from diverse manufacturers, such as food processing, automotive, plastics, and glass. Some NPDES permits fall into more than one category. For example, a manufacturer may have process wastes, site runoff, and a package sewage treatment plant. An NPDES permit deals with this situation by issuing discharge standards for three different outfall points.

At present, there are 60 NPDES permits in the Maumee RAP Area which breakdown as follows:

- 0 = Agricultural
- 2 = Electric Utility
- 30 = Industrial and Miscellaneous
- 2 = Landfill
- 4 = Quarry & Crushed Stone Producer
- 18 = Municipal and other Sewage Treatment Plants
- 4 = Municipal Water Treatment Plants

Out of these 60 permits, the status is as follows:

- 24 (40%) = not current on January 1, 1988
- 42 (70%) = active
- 4 (6%) = being sewered
- 2 (1%) = revoked or inactive
- 12 (20%) = expired, but still active

An "Active" permit is presently in operation. "Being sewered" means that the permit is active, but a sewer line is being built which will eliminate the discharge. A permit that is "Revoked" has been revoked by Ohio EPA because the facility is no longer discharging. "Inactive" means the facility is not presently discharging. "Expired" means the facility is in operation and discharging, but the permit has not yet been renewed.

There are presently no Findings and Orders for industrial NPDES dischargers in the Maumee Basin RAP Area. A list of NPDES Permits in the RAP Area, with notes on their present status and compliance, is given in Table 28. The source of these notes is from discussion with personnel of Ohio EPA Northwest District Office and Toledo Environmental Services Division, and the files of those agencies.

A complete listing of NPDES permits is given in Appendix C.

Ohio EPA is considering issuing NPDES permits for stormwater runoff to other facilities that presently have no permits. One is the Evergreen Landfill, in Northwood, which is part of the Maumee basin. Others are the truck stops in the Interchange-Five area of Lake Township, in Wood County, Lake Erie Tributaries basin.

TABLE 28

NOTES ON NPDES DISCHARGERS

NPDES DISCHARGER	STREAM	RIVER MILE	NOTES
ASHLAND OIL COMPANY NPDES: 21G00006*ED OLD NAME:	Maumee River	1.8	Permitted to treat ship ballast, but does not receive much, usually 2 to 4 times/year. Stormwater, 17,300 gpd, is treated separately.
BENTBROOK FARMS NPDES: 2PG00002 OLD NAME:	Ten Mile Creek	---	---
BOWLING GREEN WTP NPDES: 21W00010 OLD NAME:	Maumee River	22.8	Presently backwash solids are being discharged to the Maumee River. Backwash lagoons are being designed, and in the future, backwash will be recycled. New permit is being processed.
CSX-CHESSIE-PRESQLE ISLE NPDES: 21T00013 OLD NAME:	Maumee	0.1	Has had oil leak problems in the past. No information is available on the sewage treatment plant. A new permit is being processed, and the facility will be inspected before issuance.
CSX-CHESSIE-WALBRIDGE TERMINAL NPDES: 21T00002*CD OLD NAME: C&S, Chessie	Cedar Creek	2.0	Site runoff is treated, which includes a lot of oil and grease. Effluent quality is good.
CENTENNIAL MANOR NPDES: 1PY00000*DO OLD NAME:	Ten Mile Creek	2.0	---
CHARTER HOUSE INN NPDES: R 725 *AD OLD NAME:	Crane Creek	---	---
CONRAIL NPDES: 21T00015*AD OLD NAME: Penn Central	Unnamed Tributary	--	********** Problem Discharger ********** This facility has massive oil problems. Discharge goes to an unnamed tributary of the Maumee. The receiving stream is, in effect, being used to treat the runoff. There are baffles across the stream, which are used to trap the oil. They are located about 30 or 40 feet above a culvert the stream enters before flowing into the Maumee.
CONRAIL-STANLEY YARD NPDES: 21T00007*CD OLD NAME:	Cedar Creek	---	********** Problem Discharger ********** There was a major oil spill from this facility in March '88, and oil in the effluent is a continuing problem. The treatment lagoons are old, and need improvements for better control.

TABLE 28
(continued)
NOTES ON NPDES DISCHARGERS

NPDES DISCHARGER	STREAM	RIVER MILE	NOTES
DIVERSI TECH GENERAL NPDES: 2IQ00012*BD OLD NAME:	Ottawa River	6.0	Has had oil problems in effluent in the past. New oil separator has been installed, with a Permit To Install being submitted after the fact. A white solid (resin) in the effluent has been an occasional problem (TESD notes: twice in the past ten years). Toxic organics (in low concentrations) have been found in the effluent. The present NPDES permit does not have limits for these chemicals. Ohio EPA expects to add them the next time the permit is renewed.
DOEHLER-JARVIS/FARLEY, PLANT 2 NPDES: 2IC00021*FD OLD NAME:	Shantee Creek	---	********** Problem Discharger ********** Effluent includes a milky-white discharge (machine coolant). Both TESD and Ohio EPA have received complaints about this facility.
DUPONT DE NEMOURS, FORMALDEHYDE PLANT NPDES: 2IF00017*CD OLD NAME:	Ottawa River	4.8	There was at one time a formaldehyde leak to the stormwater lagoon (the NPDES Permit for this facility is for non-contact cooling water). Since that time, the lagoon has been eliminated. Ohio EPA plans reinspection.
DUPONT DE NEMOURS, PAINT PLANT NPDES: 2IF00016*DD OLD NAME:	Blodget Ditch	---	Effluent quality is good.
FONDESSY ENTERPRISES NPDES: 2IN00013*CD OLD NAME: Envirosafe	Otter Creek	2.3	One outfall had a problem with NH3 violations several years ago, but is now meeting effluent limits. Runoff covered by this permit is from the truck area, not the landfill. Landfill runoff goes to Otter Creek. Runoff from the Land Farm collected and taken to a storage tank, sampled, and discharged to the Toledo sewer system. It is sampled and discharged to the Toledo sanitary sewer system and is subject to Toledo's pretreatment program. The land farm is located at Cedar Point & Wynn, and was used for disposal of oily wastes. This practice has been discontinued. Wastes are collected, trucked, and sampled by Millren.
FRANCE STONE CO., SILICA PLANT NPDES: 2IJ00039*FD OLD NAME:	Ten Mile Creek	2.0	This facility is in compliance with its NPDES permit.
FRANCE STONE CO., WATERVILLE NPDES: 2IJ00047 OLD NAME:	Maumee River	22.2	This facility is in compliance with its NPDES permit.

TABLE 28
(continued)
NOTES ON NPDES DISCHARGERS

NPDES DISCHARGER	STREAM	RIVER MILE	NOTES
FULLER'S CREEKSIDE ESTATES NPDES: 2PH00000*BD OLD NAME:	Shantee Creek	---	---
GENERAL MILLS NPDES: 2IH00093*BD OLD NAME:	Jamieson Ditch	---	********** Problem Discharger ********** Effluent has shown violations of BOD, SS, and pH limits. BOD has shown some improvement. The problem comes from organic matter from the air pollution control equipment on the roof. This material is washed off the roof by rain, and results in a high-BOD wastewater.
HARBOR VIEW, VILLAGE OF NPDES: 2PA00012*CD OLD NAME:	Maumee Bay	---	This facility is not in compliance with its NPDES Permit. Findings and Orders have been issued. See discussion under POTWs for details.
HASKINS WWTP NPDES: 2PA00026*CD OLD NAME:	Liberty Hwy. Ditch	21.6	This facility is in compliance with its NPDES permit. Haskins WWTP is at RM 1.0 of Liberty High Rd Ditch. It empties into the Maumee at RM 21.6.
HYDRA-MATIC NPDES: 2IC00026*CD OLD NAME: GMC Chevrolet	Silver Creek	---	State of the art stormwater system. This facility is in compliance with its NPDES permit.
JEEP CORPORATION NPDES: 2IC00022 OLD NAME:	Ottawa River	7.6	New NPDES Permit is being drafted. Process waste goes to Toledo sanitary sewer. This permit is for site runoff. There are other outfalls (runoff) that are not covered by the permit. High water levels in the Ottawa River cause stream water to backflow into the treatment system. There is a lot of garbage (litter) in the stream at this site. It comes not from Jeep, but its employees.
KERN-LIEBERS USA NPDES: 2IC00056 OLD NAME:	Wolf Creek	4.1	This facility is in compliance with its NPDES permit. Ohio EPA is processing a draft permit for renewal.

TABLE 28
(continued)
NOTES ON NPDES DISCHARGERS

NPDES DISCHARGER	STREAM	RIVER MILE	NOTES
KING ROAD SANITARY LANDFILL NPDES: 2IN00079*AD OLD NAME:	Ottawa River	4.5	********** Problem Discharger ********** Ohio EPA enforcement actions are pending on this facility. OEPA's Draft Plan of Study for the Maumee BWQR notes that NH3 discharged here is 'highly elevated.' Contamination of local groundwater has been documented. This facility is an old dump. When closed, the dump was covered with sand, which allows rain water to infiltrate. In places, the cover has worn away, leaving garbage exposed on the surface. Because of the lack of impermeable cover, there is no runoff from the site. Rain water soaks into the dump and enters the Ottawa River as leachate, which contains high concentrations of BOD and NH_3. * Hydrogeological study of the area * City water for residents * Clay cap on the old dump * Fence to prohibit new dumping
LIBBEY OWENS FORD - PLANTS #4 AND #8 NPDES: 2IN00020*DD OLD NAME:	Otter Creek	6.6	********** Problem Discharger ********** Even though this plant is no longer producing, it still has an active NPDES permit. There is leachate from the lagoon through weep-holes. The lagoon has been dewatering faster than expected, and flow from weep-holes has gradually decreased. Leachate running out of banks is collected and discharged to the Toledo sanitary sewer system. The problem is that Otter Creek runs through an old, leaky sewer under the lagoon. This facility formerly produced laminated car glass. Leachate contains phthalate esters, dienoctyl Phthalate, and 2-m-butyl Phthalate. Monitor for As also, but none has been found. LOF's plans call for 1] dewatering the lagoon at this site, 2] divert Otter Creek so that it will no longer flow under the lagoon.
LIBBEY OWENS FORD - FLOAT GLASS PLANT #6 NPDES: 2IN00030*ED OLD NAME:	Maumee River	6.9	********** Problem Discharger ********** An outfall from this facility discharging to the Maumee at the Rossford Marina was discovered in Fall, 1987. Samples from this effluent contained Arsenic in 1987, but as of 1990 they no longer use Arsenic. A system of perforated collection tiles was completed in September, 1988. The leachate is to be pumped to the Toledo sanitary sewer system.
LINCOLN GREEN SUBDIV. NPDES: H 704 *AD OLD NAME:	Potter Ditch	---	---

TABLE 28
(continued)
NOTES ON NPDES DISCHARGERS

NPDES DISCHARGER	STREAM	RIVER MILE	NOTES
LIQUID CARBONIC CORP. NPDES: 2IN00069 OLD NAME:	Otter Creek	1.9	Discharge is from package sewage treatment plant, which is oversized for the number of employees. But the site is unsuited for a septic system.
MARATHON OIL COMPANY NPDES: 2IG00024*BD OLD NAME:	Driftmeyer Ditch	—	This facility is in compliance with its NPDES permit.
MAUMEE RIVER WWTP NPDES: 2PK00000*DD OLD NAME:	Maumee River	18.2	This facility is in compliance with its NPDES permit.
MEDUSA PORTLAND CEMENT COMPANY NPDES: 2IN00032 OLD NAME:	Tenmile Creek	5.3	Medusa Cement shut down in '82 or '83, but may have resumed operations. Hasn't reapplied for a discharge permit.
MIDLAND-ROSS SURFACE COMBUSTION DIV. NPDES: 2IN00072* OLD NAME:	Williams Ditch	—	This facility is in operation, but may have eliminated its discharge.
NORFOLK SOUTHERN RR NPDES: 2IT00005*BD OLD NAME: N&W RR	Duck Creek	—	This facility is in compliance with its NPDES permit. The wastewater from this facility is runoff containing oil. A treatment lagoon is used.
OAK OPENINGS - FALLEN TIMBERS PLAZA NPDES: 2PP00003*CD OLD NAME:	Murbach Ditch	—	—
OAK OPENINGS INDUSTRIAL PARK NPDES: 2PH00013*CD OLD NAME:	Kujawski Ditch	—	This facility is not in compliance with its NPDES permit. The permit has expired in September 1989. Findings and Orders have been issued.
OAK TERRACE NPDES: 2PH00014*CD OLD NAME:	Butler Ditch	—	This facility is not in compliance with its NPDES permit. The permit expired in June 1989. Findings and Orders have been issued.
OREGON SOUTH SHORE PARK WWTP NPDES: 2PB00007*CD OLD NAME:	Maumee Bay	—	This facility is not in compliance with its NPDES Permit. Findings and Orders have been issued.
OREGON WTP NPDES: 2IW00220*BD OLD NAME:	Berger Ditch	—	This facility is in compliance with its NPDES permit.

TABLE 28
(continued)
NOTES ON NPDES DISCHARGERS

NPDES DISCHARGER	STREAM	RIVER MILE	NOTES
OREGON WWTP NPDES: 2PD00035*ED OLD NAME:	Maumee Bay	---	This facility is in compliance with its NPDES permit.
OWENS-ILLINOIS, PLANT 27 NPDES: N 275 *AD OLD NAME:	County Ditch #1139	---	Ohio EPA is processing a new permit for this facility. A reinspection is planned.
PERRYSBURG WWTP NPDES: 2PD00002 OLD NAME:	Maumee River	14.5	This facility is not in compliance with its NPDES Permit. Findings and Orders have been issued. See discussion under POTWs.
PETROLEUM FUEL & TERMINAL CO. NPDES: 2IG00013 OLD NAME: Shell, Apex	Maumee River	2.2	This facility is in compliance with its NPDES permit.
PLASKON ELECTRONIC MATERIALS NPDES: 2IF00000*CD OLD NAME: Allied Chem.	Delaware Creek	1.2	This facility is in compliance with its NPDES permit.
REICHERT STAMPING NPDES: 2IS00008*ED OLD NAME: Tol. Steel Tube	Ten Mile Creek	5.1	This facility is in compliance with its NPDES permit.
STANDARD OIL - HILL AVE TERMINAL NPDES: 2IB00010*CD OLD NAME:	Fleig Ditch	11.1	This facility has occasional effluent quality problems, but is generally in compliance with its NPDES Permit. The effluent has been sampled for organic chemicals. None were found.
STANDARD OIL - TOLEDO REFINERY NPDES: 2IG00007*DD OLD NAME:	Maumee Bay	0.4	This facility is in compliance with its NPDES permit. Package sewage treatment plant(s), tributary to the main treatment plant may be in use here.
STONECO - LIME CITY PL. NPDES: 2IJ00052*CD OLD NAME: Maumee Stone Co.	Dry Creek	---	This facility is in compliance with its NPDES permit. Sewage was once treated with a package plant here. It has been replaced by a Maumee Stone Co. septic system.
STONECO - MAUMEE PLANT NPDES: 2IJ00048*CD OLD NAME: Maumee Stone Co.	Graham Ditch	---	This facility is in compliance with its NPDES permit.

TABLE 28
(continued)
NOTES ON NPDES DISCHARGERS

NPDES DISCHARGER	STREAM	RIVER MILE	NOTES
SUN PETROLEUM - MARINE TERMINAL NPDES: 2IG00009*CD OLD NAME:	Maumee River	6.5	This facility is in compliance with its NPDES permit.
SUN PETROLEUM - TOLEDO REFINERY NPDES: 2IG00003*FD OLD NAME:	Otter Creek	4.9	********** Problem Discharger ********** There have been overflow bypasses from this facility. Effluent sampling has found oil, phenol, Cr and Sulfide. A new Permit for this facility will be issued in 1989.
TELEDYNE INDUSTRIES NPDES: 2I000001*BD OLD NAME:	Silver Creek	---	This facility is in compliance with its NPDES permit.
TOLEDO BAY VIEW PARK WWTP NPDES: 2PF00000*GD OLD NAME:	Maumee River	1.4	This facility is in compliance with its NPDES permit. See discussions under POTWs and CSOs for detailed information.
TOLEDO COKE NPDES: 2ID00011 OLD NAME: Koppers	Maumee River	1.7	This facility is in compliance with its NPDES permit.
TOLEDO COLLINS PARK WTP NPDES: 2IE00260*BD OLD NAME:	Duck Creek	3.4	This facility is in compliance with its NPDES permit. There was a major spill of backwash (lime) sludge in the past, which is in the process of being excavated from Duck Creek: 6000-8000 cy in '87, and 9000 cy planned for '88. The backwash lagoons are nearly full of sludge, and will be excavated: 20-30 kcy '88, 70 kcy in '89, and 90 kcy for each of the next three years.
TOLEDO EDISON - ACME STATION NPDES: 2IB00001*CD OLD NAME:	Maumee River	4.0	This facility is in compliance with its NPDES permit.
TOLEDO EDISON BAYSHORE PLANT NPDES: 2IB00000*ID OLD NAME:	Driftmeyer Ditch	---	This facility is in compliance with its NPDES permit. Besides cooling water and sewage, the Bayshore plant also has ash ponds, which are rarely used. They exist, and Toledo Edison has them on the discharge permit only in case of emergency. Exception: the bottom ash pond is in constant use.
UNION 76 TRUCK STOP AND RESTAURANT NPDES: R 724 *AD OLD NAME:	Crane Creek	---	---

TABLE 28
(continued)
NOTES ON NPDES DISCHARGERS

NPDES DISCHARGER	STREAM	RIVER MILE	NOTES
WATERVILLE WWTP NPDES: 2IV00080*BD OLD NAME:	Maumee River	21.1	This facility is in compliance with its NPDES permit.
WHITEHOUSE WWTP NPDES: 2PB00062*CD OLD NAME:	Discher Ditch	---	Inactive facility. Tied into Lucas County sewer system.
WOODSIDE TERRACE TRAILER PARK NPDES: S702*BD OLD NAME:	Wolf Creek	---	---

MUNICIPAL WASTEWATER DISCHARGES

There are twelve municipal sewage treatment plants, or "Publicly-Operated Treatment Works" (POTWS) in the RAP Area. These include city, county, and village sewage treatment plants, plus package plants that serve suburban or rural developments. The RAP Area POTWs are given in Table 29, with 1986 effluent data. This table includes information on what treatment plant served each area in 1986, and what treatment plant is planned to serve the area in 2005. Table 29 also includes present and projected populations, flow rates, and BOD_5, SS, and P discharges in tons per year (tpy). Projected discharges for BOD_5, SS, and P assume that the plants will produce the same quality effluent in 2005 as they did in 1986.

Phosphorus Loadings

As noted in Table 27, the total phosphorus discharge from RAP Area POTWs in 1986 was 189 tons. Smaller plants are not required to monitor phosphorus, so using an estimated effluent phosphorus concentration of 2 ppm for extended aeration plants with filters, and 4 ppm without filters, the actual total phosphorus discharge would be higher than 189 tons per year. It has been calculated that the smaller plants contribute at least 9.4 tons per year (see section on Package Sewage Treatment Plants).

TABLE 29

MAUMEE BASIN RAP AREA POTWs
CURRENT AND PROJECTED
POPULATIONS AND DISCHARGE LOADINGS

SANITARY SEWER SERVICE AREA	1980 & 2005 POP.	DSGN, 1986, & 2005 FLOWS	1986 & 2005 BOD LOADS	1986 & 2005 TSS LOADS	1986 & 2005 P LOADS
LUCAS COUNTY					
Lucas County	1980 POP: 33,397	CAPACITY: 15.00 mgd			
1986: Maumee River WWTP	2005 POP: 40,257	1986: 9.01 mgd	1986: 127.2 tpy BOD	1986: 209.1 tpy TSS	1986: 11.5 tpy P
2005: Maumee River	1986 Flow: 163 gpcd	2005: 12.42 mgd	2005: 155.4 tpy BOD	2005: 255.4 tpy TSS	2005: 14.0 tpy P
Oak Openings	1980 POP: 0	CAPACITY: 0.18 mgd			
1986: Oak Openings Industrial Park	2005 POP: 0	1986: 0.11 mgd	1986: 3.8 tpy BOD	1986: 4.7 tpy TSS	1986: 0.0 tpy P
2005: Maumee River	1986 Flow: 67 gpcd	2005: 0.00 mgd	2005: 4.7 tpy BOD	2005: 5.8 tpy TSS	2005: 0.0 tpy P
Oak Terrace	1980 POP: 0	CAPACITY: 0.00 mgd			
1986: Oak Terrace WWTP	2005 POP: 0	1986: 0.10 mgd	1986: 0.7 tpy BOD	1986: 1.2 tpy TSS	1986: 0.0 tpy P
2005: Maumee River	1986 Flow: 70 gpcd	2005: 0.00 mgd	2005: 0.7 tpy BOD	2005: 1.1 tpy TSS	2005: 0.0 tpy P
Oregon **	1980 POP: 31,763	CAPACITY: 8.00 MGD			
1986: Oregon WWTP	2005 POP: 38,365	1986: 4.31 mgd	1986: 40.9 typ BOD	1986: 79.0 tpy TSS	1986: 6.2 tpy P
2005: Oregon DuPont	1986 Flow: 114 gpcd	2005: 5.41 mgd	2005: 49.4 tpy BOD	2005: 95.8 tpy TSS	2005: 7.4 tpy P
Oregon South Shore	1980 POP: 1,400	CAPACITY: 0.23 mgd			
1986: Oregon South Shore WWTP	2005 POP: 1,670	1986: 0.49 mgd	1986: 27.0 tpy BOD	1986: 22.1 tpy TSS	1986: 1.4 tpy P
2005: Oregon DuPont	1986 Flow: 350 gpcd	2005: 0.00 mgd	2005: 32.3 tpy BOD	2005: 26.4 tpy TSS	2005: 1.8 tpy P
Toledo **	1980 POP: 388,194	CAPACITY: 102.00 mgd			
1986: Toledo Bay View WWTP	2005 POP: 388,851	1986: 91.15 mgd	1986: 2,737.3 tpy BOD	1986: 6,123.6 tpy TSS	1986: 157.6 tpy P
2005: Toledo	1986 Flow: 234 gpcd	2005: 91.48 mgd	2005: 2,741.9 tpy BOD	2005: 6,133.8 tpy TSS	2005: 157.9 tpy P
Whitehouse	1980 POP: 2,819	CAPACITY: 0.29 mgd			
1986: Whitehouse WWTP	2005 POP: 3,915	1986: 0.32 mgd	1986: 8.0 tpy BOD	1986: 10.9 tpy TSS	1986: 3.1 tpy P
2005: Maumee River	1986 Flow: 113 gpcd	2005: 0.00 mgd	2005: 11.1 tpy BOD	2005: 15.3 tpy TSS	2005: 4.3 tpy P

TABLE 29 (continued)

SANITARY SEWER SERVICE AREA	1980 & 2005 POP.	DSGN, 1986, & 2005 FLOWS	1986 & 2005 BOD LOADS	1986 & 2005 TSS LOADS	
WOOD COUNTY					
Haskins	1980 POP: 568	CAPACITY: 0.10 mgd			
1986: Haskins WWTP	2005 POP: 723	1986: 0.06 mgd	1986: 0.7 tpy BOD	1986: 0.5 tpy TSS	1986: 0.0 tpy P
2005: Haskins	1986 Flow: 105 gpcd	2005: 0.08 mgd	2005: 0.9 tpy BOD	2005: 0.7 tpy TSS	2005: 0.0 tpy P
Perrysburg *	1980 POP: 17,612	CAPACITY: 2.75 mgd			
1986: Perrysburg WWTP	2005 POP: 26,010	1986: 3.00 mgd	1986: 119.2 tpy BOD	1986: 241.8 tpy TSS	1986: 8.7 tpy P
2005: Perrysburg	1986 Flow: 160 gpcd	2005: 4.48 mgd	2005: 177.8 tpy BOD	2005: 360.6 tpy TSS	2005: 13.1 tpy P
TOTAL PHOSPHORUS LOADING, 1986					188.5 tpy P

* = The Perrysburg plant is being expanded to 5.4 mgd

** = Toledo and Oregon each own and operate one package plant not listed here, because these plants do not have NPDES permits. The Oregon plant is a 5000 gpd unit that serves the City Municipal Building on Seaman Road. The Toledo plant is a 40,000 gpd package plant that serves the House of Correction in Waterville Township.

*** = This plant is soon to be replaced with a tap to the Lucas County sanitary sewer system. All three facilities listed are presently in the design or bid phase.

NOTES: 1.) Zero population denotes no information available. Zero flow for 2005 means this plant is expected to be abandoned by then.
2.) Further details on these facilities are given in Appendix E.

Findings and Orders

Ohio EPA has current Findings and Orders issued for a number of POTWs. Holders of NPDES permits are required under the Clean Water Act to be in compliance with their permits by July 1, 1988. That is the deadline for all Findings and Orders. Current Findings and Orders are detailed in Table 30.

TABLE 30

POTW FINDINGS AND ORDERS

SERVICE AREA/ FACILITY	OWNER/ OPERATOR	NPDES NO.	ORDERS TO:	DATE
Harbor View	Oregon	2PA000012* CD	Sewer surrounding area & tap into Oregon system	Pending
Interchange-Five Area	Wood Co S.D. #120	None	---	1986, To be sewered
Maumee	Maumee	None	CSOs	1985, 4-Phase CSO project
Oregon S. Shore Park	Oregon	2PB00007*CD	Effluent Limits	1986
Perrysburg	Perrysburg	2PD00002*DD	Effluent Limits	1985,

Status Of Facilities With Findings And Orders

Maumee Basin

City of Maumee

The City of Maumee is separating its combined sewers in four-phases, spaced at three-year intervals. The first phase has been completed. The separation program is scheduled for completion in 1996. This construction program will result in the elimination of 90% of the combined sewage bypasses. User fees, direct assessments and City funds will be used to finance the estimated $4 million cost of these improvements.

The existing combined sewer will serve as a sanitary sewer, and will be smoke tested to remove as many "clean water connections" (downspouts) as possible. The regulators will remain in place with slide gates controlling overflow to the river. It is estimated that a 10% inflow component from foundation drains will remain in the system. The construction schedule by district is as follows:

White Street District	1987
Sackett Street District	1990
Allen Street District	1993
Duane Street District	1996

Village of Harbor View

Harbor View has sanitary sewers, but cannot use them. The City of Oregon received a grant for a Facilities Plan for Harbor View and the surrounding portions of Oregon. The Facilities Plan (Finkbeiner, Pettis and Strout, 1981) recommended construction of an interceptor sewer to serve the area. HUD awarded a grant to the Village of Harbor View for construction of local sanitary sewers, among other improvements, but EPA did not award a grant for construction of the interceptor.

South Shore Park Subdivision of City of Oregon

The subdivision of South Shore Park in Oregon is served by sanitary sewers and its own treatment plant. The system, however, has a severe inflow problem, and the plant is overloaded by excess flow. The City of Oregon currently plans to construct an interceptor along Bayshore Road to connect South Shore Park to the main wastewater treatment plant on Dupont Road. When the Bayshore interceptor is built, the South Shore Park treatment plant will be abandoned. Construction of this interceptor will also be necessary to extend service to the Harbor View area and to Maumee Bay State Park.

Perrysburg

Perrysburg is expanding its treatment plant from 2.75 mgd to 5.4 mgd. The expansion of the primary treatment facilities has been completed; expansion of the second treatment facilities is in progress. Vacuum-assisted drying beds have also been added to the plant to improve sludge-handling capabilities. The plant upgrade is scheduled for completion in 1991.

Swan Creek Basin

Village of Whitehouse

The Whitehouse Facilities Plan (Finkbeiner, Pettis and Strout, 1978) calls for the Village of Whitehouse to abandon its existing sewage treatment plant, and tie into the Lucas County system. The Village of Whitehouse has submitted plans to Ohio EPA for construction of an interceptor to tie into the County system. Construction was completed in 1989.

Lake Erie Tributaries Basin

Interchange-Five Area

Sanitary sewers to serve the Interchange Five area have been installed. These sewers connected into the existing Wood County sanitary sewer system. Wastewater receives treatment at the Toledo Bay View WWTP.

Village of Luckey

The Village of Luckey has constructed interceptor sewers and a sewage treatment lagoon system. They went into operation in late 1987.

PACKAGE SEWAGE TREATMENT PLANTS

Package treatment plants frequently cause water quality problems. These are privately and publicly-owned treatment plants that serve mobile home parks, marinas, or restaurants in an unsewered area that produce too much wastewater for a septic tank. There are quite a few package plants in the Swan Creek watershed, especially around Toledo Express Airport, and on the fringes of the Toledo and Lucas County sewer systems.

Package plants are not a large source of pollution, in terms of the overall Great Lakes Basin. They are estimated to contribute roughly 1% of the phosphorus which reaches Lake Erie (TMACOG, 1985). However, an improperly operated package plant can have a severe effect on its receiving stream, resulting in a local health problem.

TMACOG staff has worked with OEPA and County Health Departments in the past on constructing inventories of package plants, and working with the owners and operators of the facilities to improve performance.

Most package plants use the "extended aeration" process, which is similar to the "conventional activated sludge" process commonly used by municipal sewage treatment plants. Package plants cause problems for a number of reasons, which are discussed below. The discussion below should be taken as a broad generalization.

Lack of Training and Improper Operation

The extended aeration treatment process is complicated, and unless the plant operator has received formal training, he/she probably will not understand it. Operating a package plant usually falls to a janitor, the manager, or the owner, depending on the particular situation. In most cases, the person operating the package plant has not had any training at all.

For municipal sewage treatment plants and other treatment facilities which have NPDES permits, the Operator is required to have a License; obtaining that License includes taking courses and passing tests. Most package plants are not required by law to have NPDES permits. Ohio EPA does issue NPDES permits for package plants under five conditions, however:

1. If the plant is operated by the County, or a municipality,
2. If the facility requires an NPDES permit for another wastewater discharge,
3. If the package plant is a known and continuing problem,
4. If the facility is under Public Utilities Commission of Ohio (PUCO) regulation.
5. If it is a State operated facility.

Lack of Maintenance

The maintenance problem is closely-related to the operation problem. Failure of the plant operator to understand proper operation directly results in many maintenance problems. Also, maintenance is viewed as an unpleasant job, and only conducted when required.

Lack of Enforcement

Ohio EPA has responsibility for enforcement for package plants. The main problem is that there are a lot of package plants around. Just keeping track of them has been a problem. Lack of staff to do field inspections and write letters has also been a problem.

Under a law passed in 1985, the County Health Department may contract with Ohio EPA to perform inspections and charge license fees for package plants under 25,000 gpd. Wood County has signed such a contract, but Lucas and Ottawa Counties have not. Lucas County, however, uses nuisance abatement and health statutes to conduct inspections, and attempts to visit plants monthly. They do not inspect plants which have NPDES permits. Enforcement actions remain the responsibility of Ohio EPA.

Phosphorus

In most cases, there are no data on what a given package is discharging, in terms of quantity of flow or nutrients. However, work has been done on what the effluent quality of an extended aeration package plant "typically" is. The Water Pollution Control Federation (1977) and U.S. EPA (1980) suggest figures of 2 ppm phosphorus for package plants with filters and 4 ppm without. However, these values were obtained using trained plant operators. For purposes of estimating phosphorus loadings from package plants in the RAP Area, a figure of 4 ppm P was used.

Using an estimated total package plant effluent volume of 2.09 mgd (see Appendix D), the total phosphorus contribution to receiving waters would be 12.7 tons/year. Deducting package plants listed in Appendix D which are also POTWs (Oak Terrace, Oak Openings Industrial Park, Bentbrook, Fuller's Creekside Estates, and Lincoln Green: see Appendix B) leaves a contribution of 9.4 tons P/year for the remaining plants. This number is an approximation, intended to put the phosphorus loading from this source in perspective with the other sources.

AGRICULTURAL RUNOFF WATER POLLUTION

The croplands of the Maumee River Basin are major sources of sediment, phosphorus, nitrate and pesticide loadings to the Maumee River System. These pollutants originate primarily upstream of the AOC and are transported to the lower Maumee River and Lake Erie where they negatively affect water quality.

We are fortunate to have an extensive record of sediment and nutrient loads for the Maumee River. The U.S. Geological Survey water quality monitoring site at Waterville Ohio has been in existence since 1950. The drainage area above the gauge is 6,330 square miles (USGS, 1983).

Sediment and nutrient loads for the Maumee River have been reported by the Water Quality Laboratory of Heidelberg College for U.S. EPA and are shown in Table 31.

TABLE 31

HISTORICAL SEDIMENT & NUTRIENTS FOR THE MAUMEE AT WATERVILLE

WATER YEAR	SUSPENDED SOLIDS	TOTAL PHOSPHORUS	SOLUBLE REACTIVE PHOSPHORUS	$NO_2 + NO_3$ NITROGEN
		(in metric tons)		
1982	1,280,000	2,820	576	28,400
1983	947,000	2,080	286	26,200
1984	1,080,000	2,660	389	35,450
1985	897,000	1,900	128	24,100
1986	1,221,000	2,434		30,800

Source: U.S. EPA, 1988

The extent to which these loads are attributable to nonpoint pollution sources and particularly agriculture has been the topic of several significant studies and reports. Studies performed by TMACOG, the U.S. Army Corps of Engineers Lake Erie Wastewater Management Study, Pollution from Land Use Activities Reference Group (PLUARG) of the International Joint Commission, Great Lakes National Program Office, and Water Quality Laboratory of Heidelberg College have documented the magnitude and nature of the problems affecting the Maumee River. In addition, the Ohio EPA has prepared the State of Ohio Phosphorus Reduction Strategy for Lake Erie which in turn is included in the United States Task Force Plan for Phosphorus Load Reductions from NonPoint and Point Sources on Lake Erie, Lake Ontario, and Saginaw Bay.

The conclusions of these numerous studies provide the basis for our knowledge of the fact that agriculture is a major source of pollutants (sediment, phosphorus, nitrogen, pesticides) to the Maumee River. Phosphorus and sediment have received the majority of the attention because sediment has been identified as the vehicle for transporting phosphorus. Both nitrogen and pesticides have received greater attention in recent years as public health issues.

Each of the pollutants originating from agricultural sources in the Maumee River and their impacts are discussed in the following sections.

Sediment

Sediment is considered to be the most prevalent nonpoint source pollutant by volume. By Ohio law (Agricultural Pollution Abatement and Urban Sediment Pollution Abatement Law), sediment is defined as "solid material", both mineral and organic, in suspension and being transported, or moved from its site of origin by air, water, gravity, or ice that has come to rest on earth's surface either above or below sea level." Therefore, soil particles are not considered sediment until they are detached and are being transported or have come to rest on the earth's surface.

Soil erosion is the removal and loss of soil from the land by rainfall, flowing water or wind action. Sedimentation is the resulting build-up of this soil in the downstream areas and Lake Erie.

Soil erosion rates (per acre) in the Maumee River Basin are generally low, but because of the amount of land in agriculture, erosion from cropland poses a major pollution problem. The sediment load in the Maumee River at high flow has been measured to exceed 150 thousand tons per day. The average annual sediment load from the Maumee River is 1.2 million tons per year, but it can accumulate to nearly 2 million tons per year.

There are numerous problems created by suspended and deposited sediment. Suspended sediment problems include:

1. Increased treatment costs of water supplies due to increased levels of suspended sediment. The taste and odor of the treated water can also be affected by these increased levels;

2. The reduced aesthetic quality of water for recreation purposes;

3. Reduced light penetration caused by turbidity which reduces photosynthesis thereby preventing aquatic plant growth, disrupting the food chain and impairing biological systems;

4. Decreased visibility in the water which affects the ability of fish to feed as well as creating a safety hazard for boaters, swimmers, and water skiers;

5. Provides a vehicle for the transport of phosphorus and other pollutants; and

6. Causes species extirpations and impacts on biological communities.

Deposited sediment problems include:

1. Navigation problems in Toledo Harbor and the necessity to provide annual maintenance dredging of 1 million cubic yards per year.

2. Impaired biological systems due to covering of the bottom spawning and feeding areas of fish. In addition, deposited sediment reduces the productivity of many species of aquatic organisms which are food for fish.

3. Filled drainage ditches which require expensive ditch maintenance and environmentally destructive channelization and modification to restore usage.

The Lake Erie Wastewater Management Study (LEWMS) was conducted by the U.S. Army Corps of Engineers pursuant to Section 108 of the Clean Water Act of 1972. The LEWMS used the Land Resources Information System to calculate existing Potential Gross Erosion for the Lake Erie Basin. The Maumee River Basin in its entirety was identified as having 2,596,736 acres of cropland which contributed 9,092,447 tons of potential gross erosion, or an average of 3.5 tons of soil loss to the acre under 1978 conditions (Urban, et al, 1978).

The State of Ohio Phosphorus Reduction Strategy for Lake Erie (1985) divided the Lake Erie drainage area (Ohio portion only) into 34 hydrologic groups. Table 32 identifies 14 of these hydrologic groups that make up the Maumee River Basin in Ohio (Ohio EPA, 1985). Table 32 shows that there was 3,322,095 total acres in the Ohio portion of the Maumee River Basin and the Lower Maumee River Area of Concern in 1980. These were estimated to yield 6,384,071 tons of sediment at the edge of the field or 1.9 tons/acre/year.

This difference between the Ohio Strategy and the LEWMS is likely the result of higher levels of erosion in the Indiana and Michigan portions of the basin and a difference in methodology. In either instance, both studies support the concept that there are many acres with low levels of erosion which add up to a substantial contribution of sediment to the streams and rivers of the Maumee River Basin.

These calculations of Potential Gross Erosion by the LEWMS and for the Ohio Phosphorus Strategy have been designed to develop a relationship between soil erosion on the croplands and the sediment that is actually transported to Lake Erie and its tributaries. The calculation of Potential Gross Erosion reflects the soil loss from the field. The transport of the soil particles may or may not continue for some distance until it actually arrives downstream. The sediment delivery ratio reflects the percentage of material that actually is transported to an area of deposition. The LEWMS calculated the sediment delivery ratio for the Maumee as 9.2% (USCOE, 1982). The Ohio Phosphorus Strategy calculated a delivery ratio of 13.7% for the Maumee (Ohio EPA, 1985).

Phosphorus

The phosphorus associated with sediment, as well as the phosphorus from other sources such as urban runoff, combined sewer overflows and industrial and municipal discharges, has been identified as the principle limiting nutrient in the cultural eutrophication of Lake Erie. It is also responsible for eutrophic conditions in the Lower Maumee River, Maumee Bay and the tributaries of both.

Eutrophication is a natural aging process generally describing the fertility (mainly aquatic plant productivity) of lakes. Over time, a lake will become filled with sediment and organically derived material from streams draining its watershed and from atmospheric deposition. These processes occur naturally and will fill in a lake on a geologic time scale. However, man's activities within a drainage basin can alter the natural processes in a watershed and accelerate this (extinction) process. This latter situation is referred to as cultural eutrophication to distinguish it from the natural process of aging of a lake.

Cultural eutrophication is caused by the excessive loads of aquatic plant nutrients (usually phosphorus) to natural waters. These nutrients, in turn, can produce nuisance growths of algae and higher aquatic plants which interfere with man's use of the water. While some lakes are naturally eutrophic, in that they receive a sufficient supply of phosphorus and nutrients from other sources to produce nuisance growths, an increased nutrient load to a water body has most often been associated with an intensification of human activity in the drainage area surrounding the water body.

TABLE 32

SEDIMENT AND PHOSPHORUS AFFECTING
THE LOWER MAUMEE RIVER AREA OF CONCERN

BASIN NAME (Ohio Basins Only)	TOTAL AREA (ACRES)	1980 GROSS EROSION (TONS/YR)	1980 PHOS YIELD (MT/YR)
Maumee River Subwatershed			
Maumee River Mainstem (section)	181,444	235,881	185
Maumee River Mainstem (section)	203,296	327,952	182
Maumee River Mainstem (section)	308,683	461,697	290
Maumee River Mainstem (section)	129,748	357,212	140
St. Mary's River	289,600	642,317	312
St. Joseph River	151,347	216,764	106
Tiffin River	357,200	626,537	337
Ottawa River	233,700	515,773	256
Auglaize River Mainstem	251,952	636,346	236
Little Auglaize River	261,142	680,900	316
Auglaize River Headwaters	249,105	571,666	275
Blanchard River	490,220	788,072	364
Ottawa River Subwatershed			
Ten Mile Creek	107,134	140,722	118
Lake Erie Tributaries Subwatershed			
Lake Erie Direct (partial)*	107,517	182,232	111
TOTAL	3,322,095	6,384,071	3,234

* = Includes 46% of Group 14 watersheds from the Ohio Phosphorus Strategy. This includes all of the drainage between Crane Creek and the Maumee River.

Source: State of Ohio Phosphorus reduction Strategy for Lake Erie, Ohio EPA, (1985).

A major focus of the Lake Erie Wastewater Management Study was to assess the relative importance of point source and nonpoint source contributions of phosphorus and other pollutants. Their conclusion was that even after the major wastewater treatment plants had achieved the 1.0 mg/l standard for phosphorus, there would still be a need to reduce phosphorus contributions to Lake Erie from nonpoint sources by 47% in order to upgrade the Western and Central Basins of Lake Erie to a stable trophic condition. Such improvement would generally be associated with improved water quality in that the fertility levels would be moderated and nuisance growths would be eliminated.

The Water Quality Agreement of 1983 between the United States and Canada includes Annex III which establishes a phosphorus loading target for Lake Erie of 11,000 metric tons per year. It also called upon the United States and Canada to prepare strategies to achieve this load reduction. The United States Task Force Plans for Phosphorus Load Reductions to Lake Erie, Lake Ontario, and Saginaw Bay establishes a total Lake Erie reduction of 1,700 metric tons of which Ohio is responsible for 1,390 metric tons.

Ohio has prepared the Phosphorus Reduction Strategy for Lake Erie which presents Ohio's plan to reduce 1,390 metric tons of phosphorus. Agricultural sources are considered to contribute about 64% of the total phosphorus load to the Lake. Therefore, they have been assigned 64% of the reduction, or 890 metric tons/year of phosphorus. The strategy identifies 112 watersheds in the Lake Erie Basin that are to receive priority treatment with conservation tillage. To meet the required reductions, conservation tillage practices are to be adopted on 50% of these acres.

The Maumee River Basin contains 57 of these watersheds which are divided into watershed groups according to the Planning and Engineering Data Management System for Ohio (PEMSO) developed by Ohio EPA (Table 33). These watersheds contain 1,095,979 acres of cropland which contribute 1,197 metric tons of phosphorus annually. The strategy proposed that this contribution would be reduced by 447 metric tons. This is about half of the required Ohio phosphorus reduction from agriculture.

Achieving this reduction will improve water quality in the lower Maumee River and Maumee Bay as well as Lake Erie. However, most of this problem originates upstream from the AOC and will have to be addressed in upstream areas.

TABLE 33

PROPOSED PHOSPHORUS REDUCTIONS
FOR PRIORITY WATERSHEDS BY PEMSO WATERSHED GROUP
AFFECTING THE MAUMEE AREA OF CONCERN

PEMSO WATERSHED (Group #	CROPLAND (Acres)	AGRICULTURAL PHOSPHORUS (M. Tons)	PHOSPHORUS REDUCTION (M. Tons)
Ottawa River Subwatershed			
1. Ten Mile Creek	51,364	74	26
Maumee River Subwatershed			
2. Maumee River Mainstem	90,468	116	41
4. Maumee River Mainstem	56,005	41	20
5. Tiffin River	159,418	132	63
6. Auglaize River Mainstem	78,059	73	28
7. Little Auglaize River	143,374	146	54
8. Auglaize River Headwaters	140,398	139	55
10. Blanchard River	74,189	161	42
11. Maumee River Mainstem	46,549	55	21
12. St. Mary's River	192,277	181	69
Lake Erie Tributaries Subwatershed			
14. Lake Erie Direct (Partial)	63,878	78	28
TOTAL	1,095,979	1,197	447

Source: State of Ohio Phosphorus Reduction Strategy for Lake Erie, Ohio EPA, (1985)

Nitrogen

Nitrogen is an essential plant nutrient and is applied to cropland as a fertilizer. Nitrogen is also a nutrient for aquatic plants although it is less of a limiting factor than phosphorus, and therefore, has not received the same level of attention in water quality control strategies. The concentrations of nitrate nitrogen increase during runoff events. However, nitrates are soluble and are carried to the waterway with the runoff rather than adsorbed to sediment as is phosphorus. Tile effluent often carries nitrates to the waterways.

Dr. David Baker of Heidelberg College reports that the nitrogen export rate for the Maumee River Basin is 19 kg/hectare/year (17.1 lb./acre/year) and that this is much higher than national averages. This represents an amount equal to about 50% of the amount of fertilizers applied by farmers in the basin each year and represents a significant loss to these farmers.

Table 31 shows that the annual load of nitrate/nitrite nitrogen in recent years has ranged from 24,100 metric tons to 35,450 metric tons. The 1982 water year which has been selected as a typical or average year for the Great Lakes had an annual load 28,400 metric tons of nitrate/nitrite nitrogen.

Nitrate nitrogen levels in the Great Lakes have been increasing. Lake Erie has experienced an increase of 7.95 ppb/year over the period of 1970 to 1986. The International Joint Commission has expressed concern about this increase and has recommended that research be performed to identify the effects of these increases.

Nitrate concentrations have exceeded the 10 mg/l standard on the Maumee River. This usually occurs during the spring when fertilzer application and runoff events are likely. The standard has been exceeded up to 92% of the time during May, June or July. Peak concentration for the period of time ranged from 10.3 to 12.3 mg/l. Public health concerns about nitrate nitrogen have constituted the major effect of these events. The solubility of nitrate nitrogen adds to the public health concerns about nitrates because they are difficult to remove through the standard drinking water treatment process. As a result, drinking water alerts have been issued for communities that utilize the Maumee River for their drinking supply.

Pesticides

A recent report by the Water Quality Laboratory of Heidelberg College entitled Lake Erie Agro-Ecosystem Program: Sediment, Nutrient, and Pesticide Export Studies (Heidelberg College, 1987b) is the most thorough review of pesticide loads in the Maumee River. A summary of the situation as reported in this document follows.

During spring and early summer, the concentrations of many currently used pesticides increase in Lake Erie Tributaries. In general, the concentrations of herbicides are much higher than the concentration of insecticides, and concentrations of both are generally proportional to their usage. The herbicide concentrations in these rivers appear to be higher than in many other rivers draining cropland. The effects of these herbicides on ambient water quality remain uncertain. Because of the low acute toxicity, the relatively low persistence and the insignificant bioaccumulation of most herbicides, direct toxic effects on animal life in streams and rivers appear unlikely. However, the concentrations of herbicides observed in these streams are within the range where effects on both algal and higher aquatic plant communities could be expected. Such effects may already be manifest in the existing algal and rooted aquatic plant communities in this region's streams and rivers, and within their associated wetlands and bays. Changes in these plant communities could affect the fish and invertebrate communities in streams and rivers. Also the herbicide concentrations could possibly induce behavioral responses in animals that could be detrimental to these communities.

Most of the pesticides present in streams occur primarily in the dissolved state rather than attached to the sediments. Consequently, the removal of sediments at drinking water treatment plants does not remove most pesticides. Since other aspects of conventional water treatment, such as chlorination, do not remove or alter these compounds, finished tap water has very similar concentrations of these pesticides to those found in the raw water. The U.S. Environmental Protection Agency has established health standard advisory levels in drinking water for many of the herbicides monitored in these studies. The chronic levels set in 1989 include 4ppb for Simazine, 3ppb for Atrazine, 200ppb for Metribuzin, 2ppb for Alachlor, 100 ppb for Metolachlor, and 10ppb for Cyanazine.

The concentrations of herbicides in Lake Erie tributaries do exceed some of these guidelines, for relatively short periods of maximum concentration. Activated carbon can be used to remove these compounds at water treatment plants and research is underway to evaluate other possible treatment techniques.

Table 34 contains information about the concentrations of pesticides in the Maumee River at Waterville (at the upstream end of the Area of Concern) and their extrapolated loads to the lower Maumee River. The accuracy of the load estimates is dependent on the frequency and representiveness of the pesticide samples and the flow data. Infrequent pesticide samples are more often the limiting factor of load estimates than are inadequate flow data.

TABLE 34

PESTICIDE CONCENTRATIONS AND EXTRAPOLATED LOADS

PESTICIDE	TRADE NAME	1983 Conc. ppb	1983 Load kg	1984 Conc. ppb	1984 Load kg	1985 Conc. ppb	1985 Load kg
Simazine	Princep	0	0	0.185	290.95	0.165	67.33
Carbofuran	Furadan	0.175	245.95	0.188	509.38	0.046	27.41
Atrazine	Aatrex	1.751	2476.11	2.975	4807.74	1.902	727.89
Terbufos	Counter	0.001	2.35	0	0.53	0.001	0.34
Fonofos	Dyfonate	0	0	0.002	6.45	0	0.53
Metribuzin	Sencor, Lexone	0.443	700.06	0.448	1816.42	0.254	125.68
Alachlor	Lasso	1.046	2053.38	1.756	5251.98	0.472	264.131
Linuron	--	0.036	46.86	0.040	54.96	0.013	19.81
Metolachlor	Dual	1.308	1763.06	1.574	3056.82	1.316	618.73
Cyanazine	Bladex	0.662	1160.87	1.146	2888.98	0.322	137.28
Penoxalin	--	---	59.91	---	118.51	---	0

NOTE: Concentration is the "Time Weighted Mean Concentration" and is calculated for the time period of April 15 to August 15.

Source: Lake Erie Agro-Ecosystem Program: Sediment, Nutrient, and Pesticide Export Studies (Heidelberg College, 1987b)

OPEN WATER DISPOSAL OF DREDGED MATERIAL

The Corps of Engineers (COE) annually conducts maintenance dredging of the Toledo Harbor in order to maintain the depth of the shipping channel. This dredging produces between 800,000 to 1,000,000 cubic yards of dredged material annually. In recent years (since 1970s), about 90 to 95% of the material was placed in one of the confined disposal facilities (CDF) at the mouth of Maumee Bay. In September 1984, the COE proposed to change operations to open lake dispose of about 60% of the dredged material from the Maumee Bay portion of the channel (and upper 2 miles of river channel) due to cleaner sampling. The remainder of the more polluted material was to be placed in the CDF.

U.S. EPA found that portions of the material were suitable for open lake disposal with the following stipulation:

> "Potentially adverse impacts of open-water disposal should be minimized by locating the open-water disposal sites in areas where the sediment will remain in-place and where biological productivity is relatively low (U.S. EPA, 1984).

Ohio EPA has provided annual Section 401 Water Quality Certifications (required for dumping operations) with special stipulations. In 1985 and 1986 the COE was required by Ohio EPA to conduct monitoring operations and the Toledo-Lucas County Port Authority and the City of Toledo were to explore alternatives for the reuse and or disposal of the material other than open lake disposal. In 1987, the annual 401 certification also included the following stipulations:

The Ohio EPA intends to impose the following conditions on any future 401 Certifications to dredge the federal navigation channel at Toledo harbor from lake mile 2 outward over the next four years. These conditions will be imposed provided the lake channel sediments remain classified by USEPA as suitable for open lake disposal.

1988 - The Corps shall open lake dispose an amount not to exceed 90% of the material dredged from the lake channel. The Toledo-Lucas County Port Authority and the City of Toledo are responsible for identifying reuse alternatives for at least 10% of the dredged material. This volume shall either be placed in a confined disposal facility, with the commitment that an equal amount be removed from a confined disposal facility prior to 1989 lake channel dredging, or used in a (direct) reuse project.

1989 - Same as 1988 except that the open lake disposal is restricted to 70% of the material and 30% is to be subjected to reuse alternatives.

1990 - Same as 1988 except that open lake disposal is restricted to 50% of the material and 50% is to be reused.

No open lake disposal of dredged material will take place after 1991. The Toledo-Lucas County Port Authority and the City of Toledo are responsible for identifying reuse alternatives for 100% of the dredged material. This volume shall either be placed in a confined disposal facility, with the commitment that an equal amount be removed from a confined disposal facility prior to the following year's lake channel dredging, or used in a direct reuse project (Tyler, 1987).

Differences of Opinion

There are several effects of open water disposal that have or may have negative impacts on the Area of Concern. These effects have been described and documented by various sources, however, there are still considerable differences in opinion over the extent of the impacts. Therefore, COE comments on the problems summarized below have been included.

OPEN LAKE DISPOSAL

COE Comment: Open lake disposal is considered to be environmentally suitable for disposal at the present disposal site by USEPA. Furthermore, the most recent and most specific studies and testing indicates that overall there may be no measurable negative impacts due to lake disposal. It even seems likely that lake disposal could have beneficial effects related to covering polluted bottom areas and in providing better contoured underwater habitat for fish.

Local Comment: The material does not stay at the disposal site but is dispersed by the currents and wave action. The current open lake dump site was previously used as a part of a 155 acre site where material was dumped. The COE reports that 3,840,000 cubic yards were dumped on the site from 1965 to 1975. When the site was put back into use in 1985, water depths ranged from 20 --24 feet which were very similar to the area surrounding the dump site. Had the 3,840,000 cubic yards that were placed on the site remained, then it would have formed a column rising 15.5 feet off the bottom and would result in water depths that averaged about 7 feet. Since this is not the case, and the material is gone, it is evident that it erodes away over a relatively short period of time (TMACOG, 1986).

COE Comment: Soundings clearly indicate that material dumped from 1965 - 1975 is basically still there. The dump site depths are not similar to the surrounding bottom. Calculations of depths are in error due to an error in area (640 acres vs. 155 acres). Several years of capacity remain at the present site.

Local Comment: Material from the Lake portion of the shipping channel is not similar in physical composition to the lake bottom surrounding the dump site: more silt (46% in dredged material compared to 27% in lake sediments near the disposal site); more clay (29% to 13% in lake sediments); and much less sand (25% in dredged material and 69% in lake bottom sediment). The dredged material is also higher in phosphorus (Fraleigh, Peter, 1987a). Therefore, the erosion and resuspension of the dredged materials results in the bottom sediments of the surrounding areas to be covered with lower quality dredged material.

COE Comment: The physical characteristics of dredge material varies somewhat from area to area and depending on how deep the dredge is dredging. The bottom of the Bay is certainly similar in some aspects to the dredge material because most, if not all, of the material in the Bay originally came from the same upland sources of the Maumee River. Both dredge and bottom material have also been subject to much of the same pollutant sources. Thus it seems more correct to say that both are similar than not similar overall.

SUSPENDED PARTICULATES / TURBIDITY

Local Comment: During the dumping operations, a turbidity plume is created that is persistent for the duration of dumping operations and extends well beyond the one square mile of the dump site. This turbidity plume has been observed by numerous individuals and has been extensively photographed. This corresponds with the fact that dissolved solids violated water quality standards during dumping operations (Tyler, 1986).

COE Comment: Turbidity plumes need further study as to how much material is transported or suspended. Even a trace of material may be visible and the Corps position is that practically all the material goes immediately to the bottom. Remaining quantities at the disposal site support this.

Local Comment: Laboratory tests have shown that 24% of the material remains in suspension after 24 hours (DePinto, 1986). A 1972 study has shown that the current moving across the Western Basin of Lake Erie will move 0.3 feet/second (Kovack, 1972). Therefore, the material could move 25,920 feet or 4.9 miles in 24 hours. Herdendorf has shown the average velocity of Detroit River water flow in western Lake Erie is approximately 0.5 feet/second (Herdendorf, 1969). This also demonstrates that the material can be spread around the Western Basin.

COE Comment: Hopper dredge disposal as done in the Bay with a split-hull dredge does not leave the amounts suspended as with an agitated laboratory sample. The dredge load "slides" to the bottom essentially in bulk. Most, if not essentially all, of the material is still in place after 20 years in site #2 so actual resuspension after 24 hours appears to be drastically lower than the 24% from lab testing. The remaining material in site #2 also undermines the conjecture that substantial amounts of resuspended material are transported for miles around the Bay. Survey lines one-quarter mile from site #2 also showed no change from 1985 to 1987 thus indicating no detectable movement of material.

WATER QUALITY

Local Comment: Pursuant to the provisions of the Section 401 Water Quality Certification issued by Ohio EPA, the COE conducted monitoring of water quality conditions on the dump site and in surrounding water in both 1985 and in 1986. A change in pH that violated Lake Erie Water Quality Standards was reported for 1985 (Fraleigh, 1986). The 1986 monitoring program detected several violations of Lake Erie Water Quality Standards both on and off the dump site, including copper, cadmium, iron, mercury, and dissolved solids (Tyler, 1986). This was acknowledged by COE (Clark, Col. Daniel, 1986). The 1986 monitoring program has also shown several impacts on water quality conditions around and off the dump site (Fraleigh, 1987; Stevenson, 1987).

COE Comment: The Corps interpretation of the monitoring of 1985 and 1986 was that there were no violations that could be attributed to the disposal operations. One violation noted above was from sampling done before disposal started. Other apparent violations were not true violations because simultaneous remote reference results indicated that conditions were no worse at the disposal site than at the remote reference sites. A Corps' bioassay report on the Bay is to be complete in April 1988. This hopefully should clarify some environmental misunderstandings.

Local Comment: The effect of the open water disposal on phosphorus loads has also been a topic of study. Bioavailable phosphorus concentrations in the Lake portion of the shipping channel are higher than those of the surrounding Lake according to work performed by DePinto (1986). Annual loading of bioavailable phosphorus is 101 metric tons/year or 28% of the average annual Maumee River load (Fraleigh, Peter, 1987a).

COE Comment: Annual loadings of bioavailable phosphorous is 0.4 to 0.6% not 28% as reported above.

EFFECT ON MUNICIPAL WATER SUPPLIES

Local Comment: City of Toledo has repeatedly stated that the current dump site is within an area where current will carry the material to the water intake and requested that the dump site be moved further to the East and North. Stevenson has stated that water from the dump site does arrive at the water intake (Stevenson, 1987). This conforms to the prediction of movement of the material over a 24 hour period that was described above. Movement of the material may carry toxics or other organic chemicals whose limits are below the level of sensitivity of testing performed by the COE (TMACOG, 1986).

COE Comment: As stated previously this is largely conjecture, and data needs to be developed on resuspension and its effect on phosphorous levels.

Confined Disposal Facility (CDF) Alternatives

An economically feasible and environmentally acceptable site or method for future disposal of dredged materials that are unacceptable for open-lake disposal will be required within two to five years. Within this time period, the existing active 242-acre CDF will be filled to capacity.

Disposal alternatives that have been mentioned for consideration include: upland use of the dredged material at Maumee Bay State Park, Buckeye Basin Greenbelt Parkway, and various old landfill sites; construction of a CDF along the east side of Woodtick Peninsula to prevent the continued erosion of the peninsula and provide some protection to the marshes, marinas, and other lands west of the peninsula; increasing the height of the dike around the active 242-acre CDF or around the old Island 18 (Grassy Island) CDF to increase disposal capacity; or constructing a new CDF at one of the four potential alternative locations adjacent to the navigation channel.

The preferred action identified by the COE in the Draft Environmental Impact Statement involves the construction of a new lake shore CDF (Alternative 1C) bounded on the northeast and southeast sides by the existing 242-acre CDF, on the south side by the Port Authority CDF, and on the west and northwest sides by a 4,265 foot long dike to be built to a top elevation of 23.5 feet above the LWD elevation of 568.6 feet. The new CDF would occupy about 176 acres of Maumee Bay and would provide about 162 acres of disposal area.

As long as the water quality of the lower Maumee River is significantly degraded, rapid mixing of river and bay waters appears to be important in minimizing the zone of influence of the river water in Maumee Bay. It is expected that water quality in the lower Maumee River will continue to improve, but the process will be a very gradual one. A new CDF at three of the sites considered, or even an expansion of Grassy Island to the northwest would result in reduced mixing in the "shadow zone" of the CDF. Even the construction of a CDF at the preferred site near the existing active CDF will have some impact on mixing by eliminating the 176-acre embayment area as a mixing zone and shifting the mixing zone to the north of the site.

The impacts of this construction on mixing might be greater if it were not for two ameliorating factors. First, much of the river flow does not pass by the preferred site due to an average withdrawal rate of about 1,149 cfs by the Toledo Edison Bayshore Power Plant, the mouth of whose intake canal is located at the southwest corner of the proposed CDF site. Comparing this average withdrawal rate to the discharge frequency data for the Maumee River at Waterville indicates that for the period of June through August, the river flow exceeds the power plant withdrawal rate less than 50 percent of the time. Thus, for perhaps half of the time during the summer months, water may be moving from the bay across the face of the site to the power plant intake, rather than from the river into the bay area. The second ameliorating influence is the additional water mass mixing produced by winds and seiches. The resulting movement of water masses can cause bay water to move several miles into the lower Maumee River. Thus, even when river flow rates substantially exceed the withdrawal rate of the power plant, the site will often be under the influence of bay water due to a wind or seiche induced movement of bay water up into the Maumee River estuary area.

The preferred site was selected primarily due to the fact that the amount of diking required, and thus the cost of construction, would be much lower than at any other location in Maumee Bay. Even the most efficient of designs for a 176-acre CDF at another location, such as an extended semi-circular CDF expansion of the northwest side of Grassy Island, would require a dike approximately 60 percent longer than the one proposed. Only the most serious of water quality impacts or the elimination of the most unique of fish and wild-life habitats might have precluded the selection of this site for construction of a new CDF. The water quality impacts of this alternative should be relatively minor, and the fish and wildlife resources of the site are significant but not unique.

Environmental Conditions

In 1986, the Ohio EPA conducted an extensive biological and water quality survey of the lower Maumee River, with some additional fisheries surveys in Maumee Bay. A preliminary data set of surface and bottom DO readings was taken on 8 to 10 dates between July 14 and October 8, 1986. The combined mean for River Mile 1.0 is about 5.1 ppm (range 3.3 to 6.3 ppm), for River Mile 0.5 about 5.4 ppm (range 3.6 to 7.3 ppm), and for the mouth near Presque Isle about 5.5 ppm (range 3.1 to 7.5 ppm). These values are somewhat higher than values from earlier studies indicating that some improvement in water quality has occurred between the early 1970's and the mid-1980's.

While Maumee Bay has historically been influenced by the degraded water quality of the lower river, and this influence has been increased by the construction of the 242-acre CDF, the aquatic community of the CDF site and of the rest of Maumee Bay is not a poor assemblage. The application of the pollution classification of Wright (Wright, 1955) to benthic invertebrate data indicates that the area southeast of the navigation channel is lightly polluted, the navigation channel and the area northwest of the channel is moderately polluted, and the area near the Toledo Sewage Treatment Plant discharge is heavily polluted (see Figure 6 on page 44).

Just as the water quality in the bay has apparently improved and will continue to improve, the sediment quality also appears to have improved significantly. A prime example would be that the dredged sediments from Lake Mile 2 to Lake Mile 8 are now considered suitable for open-lake disposal. Another indication of this change is the change in the benthic community of the bay. In 1930, 1961, and 1982, a series of stations throughout the western end of the western basin of Lake Erie were sampled for benthic macrofauna. From 1930 to 1961, the stations in and near Maumee Bay either remained at high level of pollution or became much more polluted, as evidenced by the number of oligochaetes per square mile and by loss of pollution intolerant organisms such as Hexagenia mayfly nymphs.

By 1982, the trend had dramatically reversed itself, at least concerning the numbers of oligochaetes. The 1930 survey results are presented in Wright (1955) and the 1961 survey results in Carr and Hiltunen (1965). The 1982 data of Manny, Hiltunen and Judd (1987) are preliminary, have not yet been statistically analyzed, and are subject to some modification. Note that while the density of oligochaetes has decreased at stations in and near Maumee Bay, the densities at most stations further offshore have remained relatively the same or increased.

CDF Impact on Fish Habitat

In spite of obvious water quality problems in the lower Maumee River and in Maumee Bay, these areas serve as valuable nursery habitat and perhaps spawning habitat for white bass and other sport and commercial species such as walleye, yellow perch, freshwater drum, and channel catfish. Mizera (1981) found the average density of larval white bass in Maumee Bay was more than five times greater than the average density east of the bay and more than seven times greater than the average density north of the bay. A similar pattern was found for freshwater drum. For larval walleye, the density found in Maumee Bay was slightly greater than that north of the bay but considerably less than that east of the bay. The density of yellow perch larvae in the bay was high but was slightly below that of the other two areas. Heniken (1977) also found somewhat similar patterns of larval distributions in his summarization of data from 1975 and 1976 for the Ohio portion of the western basin.

Based on the larval surveys of 1975 and 1976, Heniken (1977) indicates that gizzard shad production in the Ohio portion of the western basin appears to be centered mainly in Maumee Bay and that concentrations often exceeded 1,000 per 100 square miles. Gizzard shad are the most important forage species for walleye in the western basin of Lake Erie.

The data show that the preferred CDF site presently consists of a diversity of valuable aquatic habitats and that without the implementation of the proposed project, the value of these habitats would continue to increase with the improvement of water quality in the lower Maumee River. The value of these resources is sufficient to qualify their loss as significant, and that loss should be appropriately mitigated.

The proposed CDF will neither take on the appearance of an island nor add diversity to the area. It will reduce the diversity that presently exists in the CDF peninsula by reducing the shoreline length of the peninsula and eliminating the varied aquatic habitats in the existing 176-acre embayment. It is unlikely that the short-term increased utilization of the CDF area by water birds during the filling phase will outweigh the long-term loss of use of the existing 176 acres of Maumee Bay by herons, egrets, and particularly by diving ducks.

The proposed CDF is but one in a series of CDFs that have been constructed in Maumee Bay and the lower Maumee River. With the construction of the proposed CDF, almost 5 percent of the surface area of Maumee Bay will be occupied by CDFs. The cumulative impacts to fisheries have been significant and there has been no mitigation of fish habitat losses resulting from the construction of any of these existing CDFs. If a CDF is constructed at the preferred site, a combination of in-kind and out-of-kind mitigation could partially offset fish habitat losses and such mitigation should be made a part of the project.

URBAN RUNOFF

Urban runoff encompasses combined sewer overflows, as well as a significant nonpoint source of pollution. Any type of street debris that is small and light enough to be washed away by a heavy rain will end up in Lake Erie in some form, sooner or later. Contaminants in urban runoff cover a broad range, but typically include pollutants washed out of the air by rainfall, animal droppings, construction sediment, leaves, litter, salt, and oil. Some of these occur naturally; the pollution problem results from the high rate of runoff from urban areas.

A number of studies on the problems and possible solutions to urban runoff pollution have been conducted. Subjects investigated include urban soil sediment and street cleaning. Urban runoff is higher in suspended solids than sanitary sewage; the BOD is lower than in sewage, but not low enough for runoff to be considered clean water.

In developed urban areas, rainwater runs off of roof tops, sidewalks, and streets, and becomes polluted as it dissolves or washes away debris. Any debris on the street or sidewalk sooner or later ends up in a nearby stream. There are two ways to reduce urban runoff pollution from developed areas; either collect the water and treat it, or reduce the sources of pollutants by keeping debris from being washed into storm sewers to start with. This is a matter of urban housekeeping.

In newly developing areas, there are special problems related to sediment and debris from construction sites. While of limited duration, the impact of large quantities of sediment can be substantial.

Urban runoff is a significant source of nutrients: it is estimated (USCOE, 1979) to contribute 0.8 lb of available phosphorus per urbanized acre per year. This estimate was based on runoff samples taken from urban areas in the Great Lakes region. On the basis of this loading, it was estimated that for the Swan Creek watershed (TMACOG, 1985) phosphorus loadings from urban areas total roughly 13% of agricultural runoff. This would make urban runoff the second largest source of phosphorus in the sub-basin. Applying the 0.8 pound of available phosphorus per urbanized acre per year, a total of 21 tons, is the estimated phosphorus loadings per year for the RAP area. These calculated loadings are displayed in Table 35 by municipality and by TMACOG watershed.

Apart from the estimate that urban runoff yields 0.8 pound of phosphorus per acre per year to Lake Erie, no other monitoring or sampling data, specifically aimed at urban runoff, are known in the Maumee RAP area.

Salt for deicing streets is a potential source of water pollution from urban runoff. If present in high enough concentrations, salt can be toxic to aquatic life. No data are available to indicate whether deicing salt causes problems in the Toledo area.

Present Urban Runoff Control Practices

Typically, there are no urban runoff control practices in use in the older, developed urban areas. However, the City of Toledo and Lucas County enforce site drainage design regulations for new development. These regulations limit the allowable discharge rate of stormwater to a storm sewer. Any flow above the rate at which runoff occurred from a 25-year storm before development must be retained.

TABLE 35

ESTIMATED URBAN RUNOFF PHOSPHORUS LOADINGS

MUNICIPALITY	TOTAL HECTARES	TOTAL ACRES	URBAN HECTARES	URBAN ACRES	LB. PHOSPHORUS	TMACOG WATERSHED(S)
LUCAS COUNTY						
Berkey	1,052	2,599	52	128	103	1
Harbor View	4	10	4	10	8	28
Holland	112	277	84	208	166	9
Maumee	2,536	6,266	1,236	3,054	2,443	10,41,47,79
Oregon	7,432	18,364	1,776	4,388	3,511	28, 29
Ottawa Hills	448	1,107	308	761	609	6
Sylvania	1,464	3,618	808	1,997	1,597	3
Toledo	21,704	53,631	14,840	36,670	29,336	2, 6, 10,13, 14,15,22,23, 25,26,30
Waterville	568	1,404	232	573	459	41, 43, 44
Whitehouse	792	1,957	200	494	395	39, 40
TOTAL	36,112	89,233	19,540	48,283	38,627	
WOOD COUNTY						
Haskins	408	1,008	64	158	127	122
Luckey	160	395	80	198	158	83
Millbury	248	613	72	178	142	115
Northwood	2,052	5,070	496	1,226	980	43
Perrysburg	1,076	2,659	676	1,670	1,336	121, 122
Rossford	728	1,799	432	1,067	854	115
Walbridge	264	652	164	405	324	28, 29, 32
TOTAL	4,936	12,197	1,984	4,902	3,922	
TOTAL FOR AREA	41,048 Hectares	101,430 Acres	21,524 Hectares	53,186 Acres	42,549 lb P/Yr (21.3 Tons P/Yr)	

Retention/detention basins, and rooftop and parking lot stormwater storage are frequently used, as are swales and oversized ditches with restricted outlets. Design standards call for the use of passive stormwater control facilities that will work without having to be operated; e.g., the outlet from a retention basin is controlled by a small outlet to restrict flow, rather than a valve. Also, a valve can be easily removed by the owner, defeating the purpose of the basin.

Identified urban runoff control concerns include:

- Some problems and shortcomings with the present regulations. They are not stringently enforced. Regulation may be no more than paying a fee for a permit.

- Training of inspection personnel is a problem. Better awareness of the purpose of these stormwater facilities, especially relating to water pollution control, would be beneficial.

- No enforcement for proper maintenance of stormwater control facilities.

Proposed NPDES Permit Requirements for Storm Sewers

U.S. EPA (Federal Register) has been developing NPDES requirements for separate storm sewer outfalls over the past several years. The regulations developed required communities to classify storm sewers as "Group I" or "Group II," depending on the type of area drained by the sewer, and the likelihood of contaminated runoff. The filing deadline for permit applications was set at December 31, 1987. The area affected by the regulation was defined as "the most current criteria established by the Bureau of Census." A map showing the areas classified as "urbanized" by the 1980 Census is included as Figure 16. However, a lawsuit was filed, and in December, 1987, a Court of Appeals threw out the regulation (CFR 2/12/88) (Federal Register). The issue of how to regulate stormwater discharges has been remanded to U.S. EPA for further rule-making.

EPA intends to issue new regulations codifying storm water provisions found in sections 401, 405, and 503 of the Clean Water Act of 1987 in the near future. Details and proposed rules will be published for public comment in the Federal Register.

Combined Sewer Overflows

Storm runoff causes a serious pollution problem resulting from combined sewer overflows, or "CSOs." Almost every town has areas where sewage and runoff use the same, or "combined" sewers. During a storm, runoff overloads these sewers, and causes a mixture of rainwater and raw sewage to overflow into the nearest creek.

This is a serious problem, not only because of the pollution it causes, but also because it's difficult and expensive to correct. During a heavy rain, the amount of storm water flowing through the sewers is likely to be much greater than the amount of sewage.

Designing a sewage treatment plant for this peak flow rate would be expensive, and would be significantly oversized for normal flow rates. But if this peak flow surge is allowed to go through the treatment plant, it can upset the treatment processes and keep the plant from doing a good job of treating sewage for days or weeks afterward.

The best way to eliminate pollution from CSOs, from a purely environmental standpoint, is to build a separate system of storm sewers. It is standard practice to do so in new developments, and has been for many years, but in the older parts of every town, combined sewers are the rule. Separating the sewers for even a small town could cost in the millions of dollars and would require digging up the streets. These are two big reasons why separate sewer systems are rarely added to existing neighborhoods.

U.S. EPA does not award construction grants for CSO abatement projects, but allows individual states the alternative of setting aside up to 20% of total grant money statewide for otherwise nonfundable projects. In Ohio, 5% is earmarked for CSOs. The City of Toledo has been a major benefactor of this program, receiving a grant of $6.3 million for Phases I and II for its CSO abatement project.

The municipalities in the Maumee Basin Area of Concern which have CSOs are Toledo, Maumee, Northwood, Perrysburg, and Whitehouse. Areas served by combined sewer systems are shown in Figure 17. Listings of these overflow points are given in Tables 36 through 40. In Toledo, 8,902 acres are tributary to the CSO regulators (Jones & Henry, Ltd., 1978; Jones & Henry Ltd., 1978; Earthview, Inc., 1973); in Maumee, 456 acres (Finkbeiner, Pettis, Strout, 1982); and in Perrysburg, 882 acres (Finkbeiner, Pettis, Strout, 1980).

Most of Northwood is served by separate sanitary sewers. The western portion of the city is served by combined sewers. The Northwood Facilities Plan (Finkbeiner, Pettis, Strout, 1979) notes: "Wet weather from the combined sewer, which bypasses the existing intercepting manhole at Andrus Road and Sheffield Place, discharges into the Maumee River through a storm sewer of the City of Toledo. The two discharge points (overflow from Regulator No. 9 and the storm sewer) are located approximately 300 feet apart."

Toledo Combined Sewer Overflows

Toledo's combined sewer system presently has 34 overflow points to the Maumee River, the Ottawa River, and Swan Creek. The problems associated with these overflows are well-known, and have been documented in past studies (Earthview, Inc., 1973) and (Jones & Henry Engineers, Ltd., 1987). They severely degrade water quality and are aesthetically offensive.

Combined sewer overflows are controlled by float-operated gates called regulators. They are designed to direct all sewage flow to the treatment plant during normal conditions. They should bypass only when the sewer system is overloaded with stormwater. However, regulators can experience problems which cause them to bypass during dry weather.

Toledo has experienced problems with river water entering the sanitary sewer system through the regulators. This phenomenon occurred when northeast winds caused the river levels to rise. In 1987, Toledo began installing tide gates on the regulators. Most are now in place. It is too early to tell whether the new tide gates will show a significant improvement in water quality.

Toledo's regulators experience other problems as well (Jones & Henry Engineers, Ltd., 1987). One is that most of them are below Lake Erie's mean annual flood elevation. Another is debris, which causes the regulator gate to stick in the open position, and continue bypassing when it shouldn't. The regulators can experience problems from collapse of pipelines and other mechanical failures. The regulators are inspected an average of about 12-15 times per year. Also, telemetering equipment records the status of each regulator, and how many hours each day the discharge gate is open.

Toledo plans a 9-phase CSO abatement program for these areas, to be completed between 1990 and 1996. Phases 1 and 2 will be a downtown combined sewage tunnel for storing surge storm flows. The downtown tunnel will catch a 0.24 inch first flush, which is estimated to contain 85% of the pollution. Similar smaller tunnels will be built along Swan Creek as phases 3 and 4, will be designed to catch a first flush of 0.55 inches.

Other rehabilitative work is included in the CSO abatement program. The tide gates are now in place on nearly all of the regulators. Repairs and/or improvements will be made to a number of the regulators. Some sewer separation will also be done. Once the present 9-phase program is complete, Toledo plans to reevaluate the situation to determine whether improvements are needed for the remaining CSO areas along the Maumee.

A listing of Toledo's CSO points is given in Table 36, and a summary of regulator bypasses for October 1986-February 1987 (Jones & Henry Engineers, Ltd., 1987) is presented in Table 37.

TABLE 36

CITY OF TOLEDO COMBINED SEWAGE REGULATORS

Regulator No.	Name	Stream	RIVER MILE	SIZE (inches)	DRAINAGE AREA SANITARY ----(Acres)---	STORM	LOCATION
4	Paine	Maumee (E)	3.2	84	380.2	296.0	2201 Front @ Paine
5	Dearborn	Maumee (E)	4.1	90	523.7	352.0	1547 Front @ Dearborn
6	Main	Maumee (E)	4.82	60,54	207.8	174.7	Main @ Sports Arena
7	Nevada	Maumee (E)	5.8	60	581.6	608.0	609 Nevada @ Miami
8	Fassett	Maumee (E)	6.5	48	116.9	104.6	1152 Miami @ Fassett
9	Oakdale	Maumee (E)	6.85	93	638.2	467.1	1435 Miami @ Oakdale
22	New York	Maumee (W)	2.37	60	116.8	44.9	212 New York @ Summit
23	Columbus	Maumee (W)	2.85	48,102	675.9	204.9	214 Columbus @ Summit
24	Galena	Maumee (W)	3.25	30	27.6	27.5	216 Galena @ Summit
25	Ash	Maumee (W)	3.6	48	75.7	101.9	200 Ash @ Summit/I-280
26	Magnolia	Maumee (W)	4.2	48	143.3	121.2	210 Magnolia @ Summit
27	Locust	Maumee (W)	4.66	75,60	141.2	111.5	215 Locust between Water and Summit
28	Jackson	Maumee (W)	4.9	72	630.2	630.2	216 Jackson between Water and Summit
29*	Adams	Maumee (W)	4.98	24	---	---	215 Adams @ Portside
30	Jefferson	Maumee (W)	5.2	60	435.9	440.3	215 Jefferson between Water and Summit
31	Bostwick	Maumee (W)	0.07	36	---	---	315 Monroe @ Summit
32	Williams	Maumee (W)	---	---	70.3	59.9	
33	Maumee	Maumee (W)	7.5	60	345.5	343.6	502 Maumee @ Orchard
41	Knapp	Swan Creek	0.8	48	77.3	57.8	328 St. Clair @ Williams
42	Erie	Swan Creek	0.93	24	40.2	37.5	42 Erie St @ Hamilton
43	Hamilton	Swan Creek	1.1	60	292.7	349.8	Hamilton & Ant. Wayne Tr.
44	City Park	Swan Creek	1.58	30	37.9	22.2	City Pk, S. of bridge
45	Ewing	Swan Creek	1.9	48	261.9	220.2	Ewing & Hamilton
46	Hawley	Swan Creek	2.65	60	508.3	470.9	Hawley, S. of bridge
47	Junction	Swan Creek	3.15	96	867.4	841.3	Pere West, E. of Gibbons St.
48	Hillside	Swan Creek	3.45	24	190.5	49.3	Hillside & Chester St
49	Woodsdale	Swan Creek	4.3	---	547.3	17.9	Woodsdale & South St.
50	Highland	Swan Creek	4.22	---	230.6	209.3	Fearing St. in Highland Park
61	Lagrange	Ottawa River	6.45	60	555.2	167.1	3503 LaGrange @ Manhattan Blvd
62	Windermere	Ottawa River	6.7	---	958.3	865.6	202 Manhattan @ Windermere
63	DeVilbiss	Ottawa River	6.8	72	933.7	921.4	3646 Detroit @ Phillips
64	Lockwood	Ottawa River	7.75	114	---	---	3627 Lockwood @ I-475
65	Ayres	Ottawa River	8.65	54	283.5	213.4	2584 Ayres @ S. Cove
66	Monroe	Ottawa River	9.2	36	3763.0	0	3708 Monroe @ S. Cove W. of bridge

* Data refer to old regulator, which was replaced by a new unit at the end of Adams Street.

TABLE 37

TOLEDO REGULATOR BYPASSES, 10/86-2/87

Receiving Stream	No. of Regulators	October 1986	November 1986	December 1986	January 1987	February 1987
Maumee East	6	1400	1255	2376	2081	626
Maumee West	11	2089	3156	2668	2769	2871
Swan Creek	9	2404	2019	2627	2463	2028
Tenmile Creek	6	96	44	50	0	0

Maumee Combined Sewer Overflows

The City of Maumee published its CSO study in 1982 (Finkbeiner, Pettis, and Strout, 1982). It included detailed analysis of the overflow with regard to correlation between rainfall quantity, intensity, combined sewage bypasses, and their effect on the water quality of the Maumee River. While the primary focus of this study was the City of Maumee, it also included sampling on the Perrysburg side of the river. Samples were collected at two outfalls in Perrysburg, and three in Maumee. Rainfall data were collected in Maumee at four locations to correlate the response of the combined sewer system in terms of measured overflow. Sampling included primary sites (quality and quantity discharged), and secondary sites (quality only). Results of this sampling indicated high levels of BOD_5 and nutrients, and high bacteria counts.

The Maumee CSO Study concluded that rainfalls as low as 0.05 inch resulted in bypasses. These bypasses resulted in violations of the fecal coliform standards for the Maumee River, but did not have a serious impact on dissolved oxygen. The study recommended the City of Maumee proceed with a sewer separation program. A list of Maumee combined sewage regulators is given in Table 38.

TABLE 38

CITY OF MAUMEE COMBINED SEWAGE REGULATORS
(Finkbeiner, Pettis & Strout, 1982)

Regulator No. Name	Stream	Size, Inches	Drainage Area Sanitary Storm (acres)	Location
1	Maumee	12		Broadway & Ford
2	Maumee	18	38	Wayne & Kingsbury
3	Maumee	20	136	Broadway & Conant
4 *	Maumee	15	39	Broadway & Elizabeth
5	Maumee	12		Front & Ford
6 *	Maumee	24		Front & Kingsbury
7 *	Maumee	20		Front & Conant
8 *	Maumee	15		Front & Gibbs
9	Maumee	12		Key & River Road
10*	Maumee	36	113	Waite & Sackett

* = The City of Maumee's combined sewer system includes 10 regulators. Combined sanitary and storm water overflows to the Maumee at six locations: these are 33", 60", 20", 18", 15", and 60" inches in diameter, starting at the one furthest upstream. Those regulators marked with an asterisk (*) are directly above outfalls.

Perrysburg Combined Sewer Overflows

The City of Perrysburg's CSO study was prepared in 1980 (Finkbeiner, Pettis and Strout, 1980). River sampling data showed significant CSO-related increases in fecal coliform bacteria concentrations, but no serious impacts on dissolved oxygen and other water quality parameters. The study included the development of combined sewer network and receiving water quality models to evaluate various CSO control alternatives.

The Perrysburg CSO Study concluded that rainfall as low as 0.05 inch resulted in bypasses. The study recommended the capture and conveyance of CSOs to a swirl concentrator with chlorination facilities. The treated CSO would then be discharged to the Maumee River. Considering problems experienced with swirl concentrators during the years since the preparation of the CSO study, the City currently favors a combined sewer system separation project. Such a separation project would reduce the average annual CSO volume to the Maumee River by 90%. The first two phases of the sewer separation program will be constructed in 1990. The City is investing about $500,000 per year in sewer separation. Completion of the program is expected to take twenty years.

The City of Perrysburg's discharge permit (Finkbeiner, Pettis and Strout, 1980; Ohio EPA, 1982) lists overflows and bypasses as shown in Table 39.

TABLE 39

CITY OF PERRYSBURG, OHIO
BYPASS AND OVERFLOW POINTS

Ohio EPA Station No.	Description	Receiving Stream
D702002	Louisiana Ave - Water St.	Maumee River
D702003	Elm St. north of Front St.	Maumee River
D702004	Cherry St. - Water St.	Maumee River
D702005	Gorman View Subdivision	Grassy Creek
D702006	Hickory St. along Grassy Creek	Grassy Creek
D702007	Louisiana Ave. along Grassy Creek	Grassy Creek
D702008	Elm St. along Grassy Creek	Grassy Creek
D702009	West Boundary at Second	Blocked. No discharge.

Whitehouse Overflow Points

Like Perrysburg, the Village of Whitehouse's treatment plant did not have adequate capacity to treat combined sewage. Average 1986 flow was 0.32 mgd, not including bypassed sewage, to the 0.29 mgd WWTP. Whitehouse's sewer system suffered from a severe inflow/infiltration (I/I) problem.

The storm sewers were connected indirectly to the sanitary sewer system. Within the system were 8 overflow points where storm flow may be diverted to the sanitary line. Seven overflow locations discharge storm water to Disher Ditch; one overflow discharged to Lone Oak Ditch.

The Village of Whitehouse has constructed an interceptor sewer to tie into the Lucas County sanitary sewer system. Whitehouse is served by the Lucas County WWTP and has abandoned its existing WWTP. The Village of Whitehouse has mostly eliminated its CSOs. The connections between the sanitary and storm sewers have been sealed off. Dye testing is being conducted to check for any additional storm sewer connections. During heavy rains, one pump station becomes overloaded due to an inflow problem, and it is necessary to bypass to Disher Ditch. The Village of Whitehouse's old CSO points are listed in Table 40.

TABLE 40

VILLAGE OF WHITEHOUSE CSO POINTS

Regulator No. Name	Stream	Size	Location
Texas St.	Disher Ditch	8"	Texas St. S. of Waterville St.
Field Ave.	Disher Ditch	18"	Weckerly, East, Field Streets
Gilead St.	Disher Ditch	15"	South, Toledo, Maumee, Providence, Gilead Streets
Heller Rd.	Disher Ditch	12"	Heller S. of Waterville St.
Texas St.	Lone Oak Dt.	8"	Texas N. of Shepler
Gilead St.	Disher Ditch	15"	Waterville St & Alley NE of Providence St.
Providence St	Disher Ditch	10"	Providence St. S. of Otsego St.
Otsego St.	Disher Ditch	10"	Providence St. south of Otsego St.

HOME SEWAGE DISPOSAL

As reported in the Groundwater Quality Baseline Report (TMACOG, 1982), individual home sewage disposal systems affect ground water quality. The Lucas County Health Department reported leachate problems in the following areas within the county: (TMACOG, 1983a). See Figure 18.

Sylvania Township:

Area bounded by Michigan line, Whiteford Road, Alexis Road and Sylvania corporation limits.

Area bounded by King Road on west, Gower Road on east, Brint Road on south, Sylvania corporation limits on north.

Winterhaven Road and area near the intersection of Centennial and Sylvania-Metamora Roads.

Villa Farms Subdivision bounded by Central Avenue on the north, Centennial Road on east.

Monclova Township

Coder Road Area, Village of Monclova

Springfield Township

South Hill Park, Dorcas Farms, Layer Road, Village of Holland, Culley Road, Haven Park and Fairhaven Subdivisions, Devonshire Lane Subdivision.

Spencer Township

Most of township

Jerusalem Township

All areas subject to flooding.

City of Oregon

Entire area from Lallendorf Road east to City limits.

Three of the above identified problem areas, Sylvania and Springfield Townships and the City of Oregon, are of significant concern due to projected population increases. While public sewers have been targeted for these areas, facility planning must be stepped up. With implementation of the Western Lucas County Facility Plan and related segmented plans, many troublesome areas can be eliminated with tie-ins to public water and sewers.

These improvements will eliminate some package treatment plants and improve water quality in minor receiving streams. Because of the costs and cutbacks in federal funding, delays in bringing these areas on-line will continue to thwart the effect of public health improvements. Conditions will continue to worsen in areas where densities are high and existing on-site systems are failing. The soil and ground water conditions are such that at best, with a strong operation and maintenance program, the situation could be stabilized, but not significantly improved. It is imperative that those areas targeted for facility treatment system be given highest priority to reduce the health risks associated with contaminated surface and ground water conditions.

A second area of concern is in areas which are not targeted for correction in the near future. These are areas in eastern Lucas County and extreme western Lucas County outside of sewered areas, and are not near any sewer system. These on-site systems will continue to be a problem and like the on-site systems in the targeted areas of high density and priority, a sound operation and maintenance program would help, but often will not overcome the soil conditions, densities, lot size and high water table problems which are part of the landscape. Development bans are difficult to enforce and at times met with strong opposition.

The third area of concern is development in areas where soil and conditions warrant development bans or areas where systems are failing because of poor site selection in the past. These situations have resulted largely from inappropriate planning decisions and often left the health department in a reactive position rather than in a guidance and advisory role for the development.

Table 41 displays the number of septic systems and privies by minor civil division within Lucas County, including 1980 population with forecasted 1990 population and the percent change between these two decades, along with the status of active 201 facility projects as of June 1983. These statistics were taken from Table 3 and Table 8 of the TMACOG publication Home Sewage Disposal Priorities, December 1983 (TMACOG, 1983a).

Wood County and Ottawa County

The Wood County Health Department experienced a 6% decline of on-site systems from 1970 to 1980. This has resulted from many unsewered communities being sewered and much of the new development being confined to sewered areas. Although bans in some areas have been enforced, problems areas still exist and have increased. The area of major concern within Wood County is largely confined to the urbanizing areas of Lake Township which are outside of sewer districts and in sewered areas where final tie-ins have not been enforced. These areas are specifically include: Tracy Road, Millbury, areas along I-280 and Stony Ridge within the RAP study area (See Figure 18).

Health departments for both Wood and Ottawa Counties have reported problems for individual home sewage disposal systems in areas of shallow rock (less than 4 feet to bedrock) throughout their counties. Improper water well construction and abandoned water wells also cause localized problems affecting ground water.

Table 42 displays the number of septic systems and privies by those minor civil divisions within the AOC for Wood and Ottawa Counties, including 1980 population with forecasted 1990 population and the percent change between these two decades, along with the status of active 201 facility projects as of June 1983. These statistics were taken from Table 6 and Table 11 for Wood County from Table 4 and Table 9 for Ottawa County of the TMACOG publication Home Sewage Disposal Priorities, December 1983 (TMACOG, 1983a).

TABLE 41

LUCAS COUNTY STATISTICS BY MINOR CIVIL DIVISION
AND POTENTIAL CONCENTRATIONS OF ON-SITE SYSTEMS

	Septic	Other	1980	1990a	% Chg.	To be Sewered[b]	Sewered
			(by Year-Round Housing Units)				
Harbor View Village	52	7	164	154	-6.1	Step 1*	+
Harding Township	188	7	631	639	1.3	Step 1(pt.)*	
Jerusalem Township	1,101	26	3,327	3,376	1.5		
Maumee City	69	5	15,747	16,072	2.1	Step 1*	x
Monclova Township	903	25	4,285	4,467	4.2	Step 1*	
Oregon City	1,396	45	18,675	20,111	7.7	Step 1*	x(pt.)
Ottawa Hills Village	40	7	4,065	4,126	1.5	Step 2*	x
Providence Township	828	20	2,702	2,917	8.0	Step 1 (pt.)*	
Richfield Township							
Berkey Village	96		306	319	4.2		
Twp. balance	347	1	1,095	1,044	-4.5	Step 1 (pt.)*	
Spencer Township	446	36	1,744	1,758	0.8	Step 1 (pt.)*	
Springfield Township							
Holland Village	292	2	1,048	1,139	8.7	Step 1*	
Twp. balance	2,311	37	15,043	17,440	15.9	Steps 1 & 2*	
Swanton Township	975	43	3,379	3,453	2.2	Step 1 (pt.)*	
Sylvania Township							
Sylvania City	191	12	15,527	18,226	17.4		x
Twp. balance	3,844	46	17,534	18,698	6.6	Steps 1,2&3*	x(pt.)
Toledo City	750	426	354,635	336,565	-5.1	Steps 1&2*	x
Washington Township	167	4	4,000	4,159	4.0	Step 3*	x(pt.)
Waterville Township							
Waterville Village	18	—	3,884	4,537	16.8	Step 1*	x
Whitehouse Village	100	1	2,137	2,640	23.5	Step 1*	x
Twp. balance	494	8	1,813	2,030	12.0	Step 1 (pt.)*	

+ = Sewers constructed, but not connected to treatment facility.
a = TMACOG Draft Population Forecast for Lucas County 1985 through 2010.
b = TMACOG Status of Active 201 Facility Projects June 1983.
* = Out of Funding Range to receive USEPA grants in the next five years according to the Northwest District Office Ohio EPA.

1980 Census, STF 3A Table 108 (1980 Census)
(Excerpts from Table 3 and Table 8 - Home Sewage Disposal Priorities, December 1983, TMACOG)

TABLE 42

SEGMENTS OF WOOD AND OTTAWA COUNTIES WITHIN AOC DEALING WITH STATISTICS BY MINOR CIVIL DIVISION AND POTENTIAL CONCENTRATIONS OF ON-SITE SYSTEMS

	Septic	Other	1980	1990a	% Chg.	To be Sewered[b]	Sewered
	(by Year-Round Housing Units)						
WOOD COUNTY:							
Lake Township							
Millbury Village	15	—	955	1,452	52		
Walbridge Village	44	—	2,900	2,941	1.4	under construction	
Twp. balance	1,099	23	7,044	8,306	17.9	Step 3 (pt.)*	x(pt.)
Middleton Township							
Haskins Village	22	—	568	655	15.3		x
Twp. Balance	594	30	1,880	2,409	28.1		
Northwood City	150	37	5,495	6,730	22.5		x
Perrysburg City	60	—	10,215	11,559	13.2	Steps 1&2*0	x
Perrysburg Township	1,325	77	10,651	14,235	33.6	Step 1 (pt.)*	x
Rossford City	8	—	5,978	6,235	4.3	Step 1*	x
Troy Township							
Luckey Village	263	8	895	932	4.1	Step 1*0	
Twp. Balance	861	33	2,663	3,088	16.0	Step 1 (pt.)*	
OTTAWA COUNTY:							
Allen Township							
Clay Center Village	91	6	327	336	2.8	Plan of Study*	
Twp. Balance	878	23	2,995	3,319	10.8	Plan of Study*	
Benton Township							
Rocky Ridge Village	130	3	457	472	3.3		
Twp. balance	667	28	1,989	2,050	3.1		

a = TMACOG Draft Population Forecast for Wood & Ottawa Counties 1985 through 2010, December 1983

b = TMACOG Status of Active 201 Facility Projects June 1983.

* = Out of Funding Range to receive USEPA grants in the next five years according to the Northwest District Office Ohio EPA.

0 = Proceeding without Federal Funds.

1980 Census, STF 3A Table 108 (1980 Census)
(Excerpts from Tables 4, 6, 9 and 11 - Home Sewage Disposal Priorities, December 1983, TMACOG)

ACTIVE AND CLOSED LANDFILLS/DUMPSITES

As reported in the Ground Water Quality Baseline Report (TMACOG, 1982), active and closed landfills and/or dumpsites affect ground water quality. In past years, many dumpsites were created by private companies and local governments. Every political subdivision has had its dumpsite, usually in a low area along a stream just at the edge of its most populated area. These dumps were not designed to prevent leaching of chemicals and liquidized substances into surface waters or ground waters. These dumps are often sources of ground water contamination and are not monitored for their impact. The location of some dumpsites are not even known today and periodically one is found because the buried material has moved upward to the surface, or someone begins to dig a garden, or children find a leachate seep or spring to play in.

Within the past twenty years, the practice has been to site "sanitary" landfills with dependence upon clay soils to prevent leachate problems. They were still sited along a stream applying the trench and fill method, with no consideration that seasonal high water table could be within one to five feet of the surface. Underdraining with leachate collection systems were not required. In many instances during excavation, ground water had to be pumped with collapsible hoses in order to place the solid wastes in a dry trench. Leachate is generated by the infiltration of precipitation and surface runoff.

Past operational permits generally concentrated upon daily cover of the trench. Therefore, information on old sites is at best sketchy due to the fact that monitoring wells were not required. Today, however, monitoring wells and methane venting is required for new sites, or when a new cell is being established at a currently operating landfill.

Only two industrial landfills were identified in the 1981 Ohio EPA Open Dump Inventory. Both are located in the Maumee River Basin. The National Castings Midland Ross Corporation contains a 1 acre onsite landfill that contains only foundry sand. The landfill is 2,500 feet from the Maumee River.

The second site is the Rossford Landfill, a 26 acre parcel located 25 feet from Grassy Creek within the City of Rossford. The city employs the trench method using 10 acres overall. Its use is restricted to Rossford residents and businesses. There is an indication that contaminants are leaching into surface water and the Ohio EPA Northwest District Office believes that the site warrants further investigation. It has no leachate collection system, ground water monitoring plan or methane gas detection system. Depth to seasonal high water table is 1 foot. The Rossford Landfill is under orders to close by January 1991. Ground water monitoring, methane monitoring, etc., will be required as part of these orders.

Although excluded from the Ohio EPA list, there are abandoned ponds on Libbey-Owens-Ford Company property from which leachate is infiltrating Otter Creek via deteriorated sewer lines which run underneath the abandoned site. These grinding sand settling ponds, or lagoons, covered 50 acres and were used to settle fine particles of silica and felt waste products from the polishing and grinding of glass. They were abandoned prior to December 1971 and were covered with a layer of clay and are most likely unlined. It is important to note that no monitoring information from these sites is available for analysis. However, the Ohio EPA Northwest District Office reports that the leachate discharging from the Libbey-Owens-Ford waste glass settling ponds in Rossford contains arsenic.

Licensed Solid Waste Landfills

There are currently seven landfill sites in the AOC which are licensed by its respective local health department to operate. Two of these, the National Castings Landfill and the Rossford Landfill, are discussed above. The other five are described briefly following the table which displays them. These are all listed in Table 43 and displayed in Figure 19.

The Swan Creek and Lake Erie Tributaries basins did not contain any licensed solid waste landfills.

TABLE 43

LIST OF LICENSED SOLID WASTE LANDFILLS

License #	Health Department	Watershed	Landfill	Map #	Status
Maumee River Subwatershed					
48-00-01	Lucas County	Maumee	Fondessy Enterprises* Landfill #1 York St & Otter Creek Rd Oregon, Ohio	A	Closed
48-00-05	Lucas County	Maumee	Westover Landfill 820-920 Otter Creek Rd Oregon, Ohio	B	Closed
48-00-09	Lucas County	Maumee	Toledo Edison Co. Bay Shore Ash Landfill Oregon, Ohio	C	Active
48-01-06	Toledo	Maumee	National Casting Landfill Midland Ross Corp. 1414 East Broadway Toledo, Ohio	E	Active
87-00-01	Wood County	Maumee	Evergreen Landfill Waste Management 2625 E. Broadway Northwood, Ohio	F	Active
87-00-02	Wood County	Maumee	Rossford Landfill 8250 Wales Road Rossford, Ohio	G	Active
Ottawa River Subwatershed					
48-00-06	Toledo	Ottawa	Hoffman Road Landfill 4545 Hoffman Road Toledo, Ohio	D	Active

* = Envirosafe Services of Ohio

Maumee River Subwatershed

Fondessy Landfill

A 135 acre parcel located in the Otter Creek watershed in Oregon is operated as a hazardous waste site by Envirosafe Services of Ohio, Inc. It was first operated as a landfill for solid wastes for municipal and industrial disposal in the 1960's. Since the early 1980's the site has accepted only hazardous waste for disposal. These earlier solid waste cells known as landfill areas 1 and 2 and the Millard Avenue Landfill have no leachate collection system or synthetic liners. Cell F, designed for hazardous wastes, has no synthetic liner but does have a leachate collection system. However, newer cells have both. In November 1981 the Ohio Hazardous Waste Facility Board granted permission to dispose of certain types of hazardous wastes at the site under a Part A Interim Status provision under RCRA.

Two raw water supply lines owned and maintained by the City of Toledo traverse the site. The first of these water lines was installed in 1940, before the facility existed. This line is made of 78-inch coated steel pipe, lying between 11 and 21 feet below the ground surface. The second water line was installed in 1964, using 60-inch precast, prestressed concrete pipe. Together the lines deliver an average of 73 million gallons of water per day to the Collins Park Water Treatment Plant serving over one-half million people in the Toledo metropolitan area. The company maintains monitoring trenches along the water lines.

In 1983, Conversion Systems, Inc., a subsidiary of the IU International Company, acquired the Fondessy facility. The parent company later reorganized to place Fondessy under the management of Envirosafe Services, Inc., which continues to operate the site as a hazardous waste disposal facility. In the spring of 1988, NEOAX, a Hartford, Connecticut firm, acquired more than 90% of the IU International stock.

Westover Landfill

A small parcel permitted to establish operations in the floodplain of Otter Creek, it is now closed. It received municipal wastes from the residents of the City of Oregon and also industrial sludges, solvents, and paint wastes from the Dana Corporation, Johns-Manville, and two refineries, Sun and Standard. A severe leachate problem developed, with a leachate collection system being recently installed. Therefore, seepage only occurs when erosion problems opens an access for it. But erosion control systems are being installed.

Bay Shore Ash Pit

The Toledo Edison Company operates a monofill for its flyash at its location on Bay Shore Road adjacent to Maumee Bay.

Evergreen Landfill

A 265 acre parcel located in the Otter Creek watershed in Northwood, Ohio, was established in the mid-1950's as the Benton Landfill. The site was purchased by Ohio Waste Systems a subsidiary of Waste management in the mid-1970's. In December 1981 the Ohio Hazardous Waste Facility Approval Board granted permission to dispose of certain types of hazardous wastes at the site under a Part A Interim Status provision under RCRA. In November 1985, the company withdrew its application for Part B status, and now only again functions as a solid waste disposal facility. None of the cells at the site have synthetic liners and only recently has a leachate collection system been installed. It has an active methane gas monitoring system, and is working to upgrade its ground water monitoring system. It is Ohio EPA's opinion that no ground water contamination has occurred at this site (Ohio EPA, 1990d).

The Ohio EPA Northwest District Office reports that there is a staff gauge at the Evergreen Landfill. There are unusual water level fluctuations going on in the bedrock wells following storm events. The purpose of the gauge is to record water level rises in the bedrock immediately following the occurrence of rain. This monitor or staff gauge was installed by the United States Geological Survey, Columbus District Office, in connection with the Northwood Investigation of this site. Waste Management is currently conducting an additional investigation of the site. The Evergreen Landfill was granted a new solid waste Permit to Install (PTI) in April 1990 for a new area south of the present areas.

<u>Ottawa River Subwatershed</u>

Hoffman Road Landfill

A 262 acre parcel located south of the Ottawa River within the City of Toledo, with permit approval granted for Phase I in 1974. A second permit was approved in 1983 for above-grade filling to 30 feet, which relates to Area D. Generally, there are four "areas" of construction, with areas "A" and "C" considered above grade fill only, with area "B" consisting of above and below grade fill yet to be constructed. An increase in elevation was submitted in the form of a Permit-to-Install in December of 1986. An Ohio EPA Memo dated April 3, 1987 discusses the hydrogeologic and surface drainage of the site. Briefly, the Memo indicated a problem with high water table showing a mounding effect from filled cells and a discharge effect from excavated cells, and concerns with the relatively higher permeability soils in the upper 20 to 25 feet which indicate the potential for leachate migration. As a consequence of these findings, area "B" will be required to have a leachate collection system, if leachate is detected on the site, or is draining from the site. In addition, a ground water monitoring plan, a methane gas monitoring plan and synthetic liners are required. To date, no ground water contamination has been detected at this site.

<u>Closed Dumpsites</u>

With the assistance of the Northwest District Ohio EPA, the local health departments, the Toledo Environmental Services Division, and TMACOG files, a list of the known landfills and dumps are presented in Table 44 by watershed.

It is as complete a list as possible. Included with the listing is the current known status of each of the sites. Many of the sites need further investigation and remedial action plans to correct problems.

There are 56 known closed dumpsites within the AOC. Each received during its active life different types of wastes, much of it hazardous, and each has different types of problems. Many were located in low areas or floodplains along the Maumee River, the Ottawa River, Swan Creek, Otter Creek, etc. These closed sites are located in Figure 19.

TABLE 44

LIST OF CLOSED DUMPSITES BY WATERSHED

MAP #	WATERSHED	SITE NAME	CURRENT KNOWN STATUS
1	Maumee	Manhattan Dump now known as Miracle Park 2020 Manhattan Blvd. 21-34 acres, closed 1976 Deeded to Toledo in 1976 Site 1 and 2 are now contiguous.	Demolition Dump had underground fires from alumina oxide powder, but no fire hazard today; past leachate migration, none at present; has vegetative cover, but closure status is uncertain.
2	Maumee	Treasure Island Landfill Manhattan, New York & Counter Streets 150 acres, closed 1965	Industrial & Municipal Wastes Had chemical & underground fires; but no fire hazard today; Magnesium was the cause of the fires; has a 6" to 12" clay caps. Planned to become a park.
3	Maumee	South Avenue Dump at the Maumee River 50 acres in low area. Operated 1950 to 1957 - constructed over the fill are the Anderson & Cargill Grain Elevators, Ohio Bell & Kuhlman Concrete	Mixed municipal and industrial wastes with heavy metals and organics. Cargill installed sumps 20 to 30 feet deep in 1983, was discharging to Maumee River, but, holding tanks are being installed in order to treat the discharge. Prior to its use as a dump, these were settling ponds used by Libbey-Owens-Ford. Leachate from these are high in Arsenic.
4	Maumee	NL Industries aka Bunting Brass & Bronze, 715 Spencer 10 acres, 1916 to 1980 currently Eagle-Picher Bearing Co.	Presumed storage of drosses which would contain heavy metals
5	Maumee	Gulf Oil Refinery 2935 Front Street 2.75 acres sediments & sludges, 1953 to 1981 4 acre landfarm 4 separator ponds	Hazardous Wastes - Principal concerns are the landfarm with leaded sludge, followed by weathering area, the landfill and sludge pit areas
6	Maumee	Owens-Illinois, Inc. Libbey Plant 27 940 Ash Street 1883 to present	In 1800s some 10,000 Cu. feet of old furnaces and other waste materials are buried at the site containing arsenic & chromium

(continued)

TABLE 44
(continued)

LIST OF CLOSED DUMPSITES BY WATERSHED

MAP #	WATERSHED	SITE NAME	CURRENT KNOWN STATUS
7	Maumee	Florence Street	Was an open dump
8	Maumee	St. Mary's Street	Was an open dump
9	Maumee	Columbus Street	Was an open dump
10	Maumee	Buckeye Street	Was an open dump
11	Maumee	Mulberry Street	Was an open dump
12	Maumee	Buckeye Basin	Was an open dump
13	Swan	Western Avenue	
14	Swan	Angola Road Mobile Home Park constructed over site	Leachate contains iron
15	Swan	Arlington Avenue	
16	Swan	Swan Creek Landfill Glendale at Swan Creek	Could not be located in the field; may have apartment complex constructed on top
17	Swan	Scott Park	
18	Swan	Holland Village	
19	Swan	Springfield-Monclova Twps.	
20	Swan	Swanton Township	
21	Swan	Providence Township	
22	Swan	Spencer Township	
23	Otter (Maumee)	Sun Oil of Pennsylvania 1819 Woodville Road 1940-1950 tank bottoms contaminated with lead disposed in 37 pits within the dikes of the tank farm.	Contents of 37 pits later excavated and disposed of in onsite landfill adjacent to tank farm; monitoring wells are in place.

(continued)

TABLE 44
(continued)
LIST OF CLOSED DUMPSITES BY WATERSHED

MAP #	WATERSHED	SITE NAME	CURRENT KNOWN STATUS
24	Otter	Union Oil Co. of CA (UNOCAL) 1840 Otter Creek Road Operated as refinery until 1967 when sold to SOHIO, but still operated a petroleum products storage terminal	Concern for tank diked area to retention pond which is for oil and water separation, an NPDES permit is in preparation.
25	Otter (Driftmeyer Ditch)	Heist Corporation 3816 Cedar Point Road In 1981, old oil sludge pit in depressed area filled in.	Problems surfaced again in 1983 with black oily sludge breaking through earth cover; problem corrected but began oozing again in 1985 - no known offsite discharge currently
26	Otter (Maumee)	British Petroleum (BP) 4100 Cedar Point Road 1970s start of 5 acre landfarm for sludges, emulsions; leaded tank bottoms buried in small pits within tank farm.	Monitoring operation in place; all stormwater is collected and treated.
27	Otter	Westover 820 Otter Creek Road Municipal wastes, industrial	Leachate collection system recently installed and erosion control system being developed sludges, solvents & paint wastes
27A	Otter	Gradel Landfill (Old Westover Landfill) 1150 Otter Creek Rd. municipal, industrial, commercial wastes accepted from 1969-1975. After closure, site purchased by Commercial Oil Services, Inc.	A pond way excavated atop the landfill, which induces leachate production; analytical results on leachate samples show elevated aluminum, ammonia-nitrogen and traces of organic pesticides.
28	Otter (Maumee)	Fondessy Landfill #1 site west of Otter Creek Rd. demolition wastes	Monitoring operation to be expanded
29	Ten Mile	King Road Landfill 3535 King Road, 44 acres Operated by Lucas County from 1954 to 1976	Potential ground water contamination from leachate migration containing metals--chromium, lead, enforcement action pending

continued

TABLE 44
(continued)
<u>LIST OF CLOSED DUMPSITES BY WATERSHED</u>

MAP #	WATERSHED	SITE NAME	CURRENT KNOWN STATUS
30	Ottawa	Owens-Illinois, Inc. Technical Center 1700 North Westwood On-site Landfill	Chromium and lead sludges; test borings performed show no contamination discovery.
31	Ottawa	Owens-Illinois, Inc. Hilfinger Site 1800 North Westwood Hilfinger landfilled on-site electroplating & metal finishing wastes Closed in late 1970s.	Soil had been contaminated by heavy metals-chromium, arsenic, cadmium, nickel, zinc. Clean up completed with polyethylene liner and monitoring wells. Currently a parking lot.
32	Ottawa	South Cove Blvd.	
33	Ottawa	Willys Park	Part of North Cove Blvd. AMC investigation
34	Ottawa	Joe E. Brown Park Manhattan Blvd.	Presently a ball field
35	Ottawa	North Cove Landfill North Cove & Drexel Dr. Operated by AMC as land-fill from 1941 to 1970. Industrial residues i.e. solvents & sludges, now owned by the Chrysler Corp.	During installation of a sanitary sewer west of site in 1979, hydrocarbon fumes were encountered. Ground water sampling performed indicating presence of hydrocarbons and low boiling solvents. Chrysler, ODOT, and Toledo are planning to conduct a remedial investigation/ feasibility study.
36	Ottawa	Sheller-Globe Corp., Armored Plastics, Lint & Dura Avenues Approx. 100 drums of Paint Residues disposed	Solvent portion believed to have evaporated leaving only residue.
37	Ottawa	Tyler Street Dump Operated by City of Toledo, located end of Tyler St. north of Ottawa River Municipal & industrial wastes	Leachates to Ottawa River

(continued)

TABLE 44
(continued)
LIST OF CLOSED DUMPSITES BY WATERSHED

MAP #	WATERSHED	SITE NAME	CURRENT KNOWN STATUS
38	Ottawa	Stickney Avenue Landfill Owned by American Motors Corp. located southeast of Ottawa River Industrial wastes i.e. solvents & sludges	Leachates to Ottawa River composed of low conventional pollutants and organics
39	Ottawa	Dura Dump, 70 acres Operated by City of Toledo Located northwest of river Municipal, Industrial and Demolition Wastes - Opened 1952, closed 1980.	Leachates to Ottawa River containing PCBs, organics. Under investigation with a remedial action plan being developed. Enforcement is pending.
40	Ottawa	DuPont Waste Lagoon Matzinger Road 2% formaldehyde solution	Lagoon filled in. Site drainage patterns unknown, but no discharge to river.
41	Duck Creek (Maumee)	Consul Street Dump Operated by City of Toledo from 1948-1966, now site of Parkway Mobile Home Park solvents & paint sludges	Leachate collection system to sanitary sewer; water table within 6 feet of surface Methane Gas Venting; ongoing Ohio Dept of Health Study
42	Silver/ Shantee (Maumee Bay)	Jackman Road	Was an open dump
43	Silver/ Shantee (Maumee Bay)	NL Industries/Doehler-Jarvis/Farley Metals Inc. Toledo, Ohio	Past on-site storage for Plating Sludges 5400 N. Detroit Avenue
44	Crane (Lake Erie Tributary)	Millbury Village	Leachate problem; solid wastes Site 44 & 45 may be the same site.
45	Crane (Lake Erie Tributary)	Asman Dump St. Rt. 795 & Fostoria Rd.	Leachate problem; solid and hazardous waste
46	Grassy (Maumee)	Perrysburg Township	
47	Grassy (Maumee)	Perrysburg City St. Rt. 795 & Glenwood Rd.	

(continued)

TABLE 44
(continued)
LIST OF CLOSED DUMPSITES BY WATERSHED

MAP #	WATERSHED	SITE NAME	CURRENT KNOWN STATUS
48	Cedar (Lake Erie Tributary)	Walbridge-Lake Township	
49	Wolfe (Maumee Bay)	Jerusalem Township	
50	Duck	Oregon, Millard Ave. Overpass route, west of Duck Creek	PAHs from coal tars found in soil 6 to 15 feet deep. May be from waste material dumped from Coal Gas Reservoir once located at York and Front Streets.
51	Swan	Swan Creek near South Ave. at Woodsdale Bethel Lutheran Church	Old dump of household wastes and demolition debris. Church built on top of the dumpsite in 1953.
52	Swan	1401 to 1463 Western Ave Swan Creek	Household and Commercial wastes; closed in 1930
53	Swan	Chester Street to Swan Creek	Household and Commercial wastes; operated from 1948 to 1955
54	Swan	Louie Street to Swan Creek	Household and Commercial wastes; operated from 1920 to 1955
55	Swan	Swan Creek, south bank and west of Champion Street to the creek	Household and Commercial wastes; about 10 acres; operated from 1945 to 1950
56	Swan (Drennan or Butler Dt)	Irwin Road (west side) north of Angola Road)	Household and Commercial wastes; five acre site; 1948-1952 or longer
57	Little Cedar Creek	Wood County WWTP, 5555 Woodville Road at Walbridge/Matthews Rds.	Three transformers containing PCBs buried at site of former sewage treatment plant.
58	Maumee	Old Peanut Hill Dump: Oak St near Akron, Oaklawn & Richford streets, East Toledo	Low area filled in ca. 1920-40 Houses built on-site in 1950s. Materials dumped are unknown.

Pits, Ponds and Lagoons

The Ohio EPA conducted a statewide assessment and inventory of surface impoundments during 1978 and 1979. The purpose was to determine their polluting effect upon underground drinking water sources. This project was referred to as the Surface Impoundment Assessment (SIA). By definition, surface impoundments include any earthen pond, pit or lagoon used for the storage, treatment or disposal of wastewaters and other fluids related to industrial, municipal, agricultural, mining, and oil and gas related activities.

With the assistance of the Northwest District Ohio EPA, TMACOG examined the SIA file for the Counties of Lucas, Wood and Ottawa. A list of the known pits, ponds and lagoons as listed in this SIA file are presented in this section by watershed in Table 45. Included with the listing is the Map #, watershed name, Facility Identification No., the number of impoundments at the site, the purpose of the impoundment, the age of the facility at the time of the survey, the size of impoundments, the recorded gallons per day if known, and the scored ground water contamination potential rating (GWCPR). The highest ground water contamination potential rating a site could receive is "29" while the lowest is "1". The NPDES number is also included if such number had been assigned.

There are 36 sites which include some 68 impoundments within the AOC. None of the impoundments as shown in the SIA file were lined by today's standards, nor were monitoring wells in place for water quality sampling purposes. Generally, this ten year old SIA file indicated that it was "unknown" whether the impoundment had an adverse affect by seepage to water quality of drinking water wells in the area. The SIA was based on a file review by Ohio EPA. The ground water contamination potential ratings were not based on field observations. A map (Figure 20) displaying these impoundment sites follows the table.

TABLE 45

LIST OF IMPOUNDMENTS BY WATERSHED

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
1	Maumee	09581858MUN00236 NPDES OH003719 Waterville Water Treatment 16 North Second Street Waterville, OH 43566	(SIC 4941) 1 impoundment; waste storage sludge; 4 years; 0.03 acres	13
2	Maumee	09581858IND00274(SIC 3222) NPDES OH0002631 Johns-Manville Products Corp. 6055 River Road Waterville, OH 43566	(SIC) 3 impoundments; wastewater stabilization; 13 years; 0.12 acres, total - 0.35 acres; 120,000 gallons/day	17
3	Maumee	09581858IND00275 NPDES OH0054011 Johns-Manville Products Corp. U.S. 24 & Dutch Road Waterville, OH 43566	(SIC 3222) 3 impoundments; wastewater stabilization; 13 years; 0.15 acres, total - 0.5 acres; 36,000 gallons/day	6
4	Maumee	09577000IND00866 Consolidated Dock, Inc. Western Division 636 Paine Avenue Toledo, OH 43605	(SIC) 1 impoundment; wastewater retention; 3 years; 0.06 acres <u>Note from SIA file</u>: stormwater runoff = salt piles, coal, slag, etc.	19
5	Maumee	09577000IND00207 NPDES OH0002810 Gulf Oil Co. U.S. Div. Gulf Oil Corp. 2935 Front Street Toledo, OH 43697 (Ceased operation)	(SIC 2911) 4 impoundments; waste treatment settling; 15 years; 0.5 acres, total - 1.0 acres; 864,000 gallons/day	16
6	Maumee Bay	09558730IND00239 NPDES OH0002925 Toledo Edison Co. 4701 Bay Shore Road Oregon, OH 43616	(SIC 491) 3 impoundments; wastewater settling; 4 years; 31 acres, total - 50 acres; 3,100,000 gallons/day	17

(continued)

TABLE 45
(continued)
LIST OF IMPOUNDMENTS BY WATERSHED

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
7	Maumee Bay	09558730MUN00244 NPDES OH0041815 Oregon Water Supply 935 North Curtice Road Oregon, OH 43616	(SIC 4941) 1 impoundment; waste storage of sludge; 18 years; 1.5 acres	18
8	Swan	09584770IND00863 American Can Co. 10444 Waterville-Swanton Rd. Whitehouse, OH 43571	(SIC 3411) 1 impoundment; wastewater retention; 4 years; 0.5 acres; 30,000 gallons/day	17
9	Otter	17341328IND00225 NPDES OH0002453 Libbey-Owens-Ford Co. 811 Madison Avenue Toledo, Ohio 43624 1701 East Broadway Toledo, OH 43605	(SIC 3211) 4 impoundments; waste treatment settling; 30 years; 21 acres, total - 67 acres LAST YEAR OF OPERATION 1966 Note from SIA file- Abandoned & capped(with clay) "sand ponds" with leachate problems, LOF pond "J".	16
10	Otter	09577000IND00226 NPDES OH0002453 Libbey-Owens-Ford Co. 1701 East Broadway Toledo, OH 43605 (Ceased operation)	(SIC 3211) 2 impoundments; waste treatment settling; 6 years; 7.5 acres, total - 19.5 acres	14
11	Otter	09577000IND00206 NPDES OH0002763 Sun Oil Co. of Penn. Toledo Refinery P.O. Box 920 Toledo, OH 43693	(SIC 2911) 3 impoundments; waste treatment equalization; 29 years; 7.5 acres, total - 8.5 acres; 3,600,000 gallons/day	16
12	Otter	09577000IND00894 NPDES OH0058581 Phillips Petroleum Co. 275 Millard Avenue Toledo, OH 43605	(SIC 3624) 4 impoundments; wastewater settling; 10 yrs; 0.26 acres, total - 1.04 acres	13

(continued)

TABLE 45
(continued)
LIST OF IMPOUNDMENTS BY WATERSHED

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
13	Otter	0957700IND00892 C.H. Heist Corp. 3805 Cedar Point Road Toledo, OH 43694	(SIC 299) 3 impoundments; waste storage; 7 years; 0.03 acres, total - 0.09 acres	14
14	Otter	09558730IND00223 NPDES OH0058629 Commercial Oil Services, Inc. 3600 Cedar Point Road Oregon, OH 43616 (Ceased operation)	(SIC 2999) 3 impoundments; waste disposal; 13 years; 0.18 acres, total - 1.43 acres	18
15	Otter	09558730IND00865 Bills' Road Oil Services 3500 York Street Oregon, OH 43616	(SIC 2899) 2 impoundments; waste disposal; 9 years; 0.12 acres, total - 0.25 acres	17
16	Otter	09558730IND00249 NPDES OH0053864 Fondessy Enterprises, Inc. 876 Otter Creek Road Oregon, OH 43616	(SIC 2999) 1 impoundment; waste disposal; 11 years; 1.2 acres	17
17	Otter	09577000IND000208 NPDES OH0002461 Standard Oil of Ohio Toledo Refinery P.O. Box 696 Toledo, OH 43694	(SIC 2911) 2 impoundments; waste storage oil sludge; 33 years; 2 acres, total - 10 acres	16
18	Ten Mile	09576022IND00278 NPDES OH0058521 Northern Ohio Asphalt Paving 7920 Sylvania Avenue Sylvania, OH 43460	(SIC 2952) 1 impoundment; wastewater settling; 2 years; 0.25 acres; 144,000 gallons/day	17
19	Ten Mile	09572452IND00276 NPDES OH0033715 Medusa Cement Co. P.O. Box 310 Silica Plant Sylvania, OH 44350	(SIC 3241) 1 impoundment; wastewater settling; 6 years; 0.25 acres; 500,000 gallons/day	15

(continued)

TABLE 45
(continued)
LIST OF IMPOUNDMENTS BY WATERSHED

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
20	Ottawa	09577000IND00233 Cleveland Metal Abrasive Co. 2351 Hill Avenue Toledo, OH 43607	(SIC 3291) 1 impoundment; waste treatment settling; 6 years; 0.03 acres; 460,800 gallons/day. <u>Note from SIA file</u> - 2 cell settling - av. flow value is design flow.	16
21	Ottawa	09577000IND000864 Incorporated Crafts, Inc. 3905 Stickney Avenue Toledo, OH 43608	(SIC 2899) 2 impoundments; waste disposal; 14 years; 1.5 acres, total - 3 acres	17
22	Ottawa	09577000IND00891 Royster Co., Inc. Creekside Avenue P.O. Box 6986 Toledo, OH 43612	(SIC 2875) 1 impoundment; waste water retention; 28 years; 2 acres. <u>Note</u> - surface runoff pond was developed to collect discharge.	15
23	Duck	09577000MUN00249 NPDES OH0030759 Toledo Water Treatment Plant 600 Collins Park Avenue Toledo, OH 43605	(SIC 4941) 2 impoundments; waste storage sludge; 26 years; 16 acres, total - 48 acres	16
24	Duck	09537478IND00277 NPDES OH0003000 Norfolk & Western Railway Ironville Yard 2750 Front Street Toledo, OH 43605	(SIC 4011) 1 impoundment; wastewater retention; 8 years; 0.5 acres	18
25	Duck	09577000IND000895 Westway Trading Corp. Ind Molasses Division Box 186, Station A 431 John Q. Carey Drive Toledo, OH 43605	(SIC 2875) 2 impoundments	

(continued)

TABLE 45
(continued)
LIST OF IMPOUNDMENTS BY WATERSHED

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
26	Silver/ Shantee	09577000IND00234 NPDES OH0002640 General Motors Corp. 1455 West Alexis Road Toledo, OH 43612	(SIC 3714) 1 impoundment; waste treatment retention; 20 years; 0.75 acres; 100,000 gallons/day	18
27	Grassy	17362148IND00217 NPDES OH0003107 Owens-Illinois, Inc. P.O. Box 1035 Toledo, OH 43601 25875 U.S. Route 25 Perrysburg, OH 43551	(SIC 2893) 1 impoundment; waste treatment polishing; 12 years; 7 acres; 20,000 gallons/day. Note from SIA file - old DOT borrow pit - age uncertain.	14
28	Cedar/ Crane	17343610IND00876 NPDES OH0003573 Maumee Stone Co. Perrysburg Plan 8812 Fremont Pike Perrysburg, OH 43551	(SIC 1422) 4 impoundments; wastewater settling; 14 years; 0.5 acres; 138,000 gallons/day	23
29	Maumee	17351114IND00228 NPDES OH0057835 Penn Central Transportation 6 Penn Center Philadelphia, PA 19103 Stanley Diesel Shop 435 Emerald Avenue Toledo, OH 43602	(SIC) 1 impoundment; wastewater retention; 25 years; 7 acres; 5,000 gallons/day. Note from SIA file- old borrow pit, age unknown.	18
30	Cedar/ Crane	17380486IND00227 NPDES OH0002488 Chesapeake & Ohio Railway Co. P.O. Box 1800 Huntington, WV 25718 Walbridge, OH 43465	(SIC) 1 impoundment; wastewater retention; 9 years; 0.12 acres; clay liner	15
31	Cedar/ Crane	17341328IND00910 NPDES OH0003212 Burndy Corporation Richards Avenue Norwalk, OH 06856 Toledo Facility P.O. Box 817 Toledo, OH 43601	(SIC 3471) 1 impoundment; waste treatment retention; 11 years; 0.25 acres; 65,000 gallons/day. Ceased operation in 1976	17

(continued)

TABLE 45
(continued)
LIST OF IMPOUNDMENTS BY WATERSHED

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
32	Cedar/ Crane	17357190IND00880 Hirzel Canning Co. 411 Lemoyne Road Toledo, OH 43616	(SIC 2033) 3 impoundments; wastewater aerated; 11 years; 1.25 acres, total - 3.75 acres; 30,000 gallons/day	16
33	Cedar/ Crane	1735020IND00908 Standard Oil Co. of Ohio 1800 L. Midland Bldg. Cleveland, OH 44115 1-280 & S.R. 795 Millbury, OH 43447	(SIC 299) 1 impoundment; waste treatment retention; 3 years; 0.02 acres; bentonite modified liner	15
34	Cedar/ Crane	17350260IND00229 NPDES OH0003221 Molnar Packing Co. Pemberville Road Millbury, OH 43447	(SIC 2011) 1 impoundment; wastewater aerated; 7 years; 1.2 acres; 7,050 gallons/day. Note from SIA file - two celled lagoon.	13
35	Cedar/ Crane	12301322IND00231 NPDES OH0003425 Permaglass Div. Guardian Industries Routes 51 & 795 Millbury, OH 43447	(SIC 0321) 1 impoundment; waste treatment biologic; 9 years; 2.3 acres; 30,000 gallons/day	13
36	Cedar/ Crane	12319736IND00210 NPDES OH0002755 Stokely-Van Camp, Inc. 941 N. Meridan Street Indianapolis, IN 46206 at Curtice, OH 43412 (Ceased operation)	(SIC 2033) 2 impoundments; waste treatment aerated; 26 years; 2.5 acres, total - 4.4 acres; range 150,000 to 269,000 gallons/day. CEASED OPERATION IN 1979 Note in SIA file - 2 lagoons inventoried, but 2nd lagoon partitioned to form 2 for a total of 3 lagoons.	17

Water Quality Impacts

The Subcommittee's greatest concern deals with the Dura Dump, the LOF Grinding Sand Settling Ponds, and the King Road Landfill. Of obvious concern, too, are the wall-to-wall dumps once sited in the floodplains of the Ottawa River. The various closed sites have degrading impacts on water quality as shown when analyzing the Ohio EPA Water Quality Data Summary conducted during the summer of 1986.

The headwaters of the Ottawa River start in Michigan and flow through western Lucas County where it is known as the Ten Mile Creek. Upstream of the King Road Landfill at River Miles 5.2 and 5.1 (Centennial Road) the water quality is considered good, the primary influence being agriculture. The Dissolved Oxygen is 5.2 to 9.7 mg/l. Metals are near or below the detection limit, as are phenolic samples.

The King Road Landfill is located below River Miles 4.1 where water quality is considered fair to marginally good. This site was closed in 1976, with leachate problems developing in 1972. Heavy metals flowing from the site caused Lucas County to provide a municipal water line to those homes whose water wells were contaminated. Midwest Environmental Consultants has prepared an environmental assessment for the site, and has made recommendations for further investigations. Existing conditions at the site include loose garbage on the surface, insufficient grade, ponding of water, and serious erosion in many areas.

The North Cove Landfill site along the banks of the Ottawa River at River Mile 8.7, was formerly owned by American Motors. It operated from 1941 until 1970 where industrial residues were disposed of. During the installation of a sanitary sewer west of the site in 1979, hydrocarbon fumes were encountered. Ground water sampling was performed and indicated the presence of hydrocarbons and low boiling solvents. A site assessment was done for the landfill and a remedial investigation/feasibility study is to be conducted by AMC.

Lake Erie dilutes the polluted Ottawa River up to 4.9 miles from the mouth. The Dura, Stickney and Tyler dumps all owned by the City of Toledo, are located along the Ottawa River wherein a lake estuary effect takes place. Also in the vicinity are three Combined Sewer Overflows, and discharges from DuPont and AMC. Leachate samples from the Stickney Avenue site contain low to moderate levels of conventional pollutants and very low levels of organic priority pollutants.

At the Dura Dump the leachate contains high BOD, COD and organics. Among these organic chemicals are PCBs. The range of concentration of PCBs in the Ottawa River Sediment from sampling taken October 1986 is 0.86 to 9.7 parts per million. One sample taken from the river bank was as high as 135 parts per million. The six leachate seeps to the Ottawa River have been modeled to be 54,700 gallons per day. The City of Toledo has initiated a Remedial Investigation/Feasibility Study being conducted by URS Corp. Actions have been implemented to control leaching and runoff at the site. Clean up costs have been estimated to be $40 million.

The degradation of Otter Creek is directly related to the LOF site. At River Mile 5.9 (Oakdale Street) downstream of the LOF site, the Dissolved Oxygen is 1 mg/l, pH ranges from 8.6 to 10.2; Arsenic is 350 ug/l; Copper ranges from 17 to 30 ug/l. The water quality is considered to be very poor. Only upstream at River Mile 7.2, where Otter Creek is a small ditch-like stream, is the water quality considered to be fair.

At River Mile 5.7 (Pickle Road) there are noxious smelling chemicals, a reddish brown flocculent, hydrogen sulfide, etc., with the stream and banks at River Mile 4.0 (Wheeling Street) being oil soaked, with nickel and cyanide also being detected. The Sun Oil Refinery discharge is upstream at this point. At River Mile 2.1 (Millard Avenue), while the water quality is still degraded, it is slightly improved due to the Lake effect on Otter Creek. It is important to remember that Evergreen, Fondessy, and Westover sites each have leachate collection systems in place.

The ten dumpsites on Swan Creek do not appear to have severe water quality impact but this may be due to lack of thorough investigation of sediments and fish sampling.

For the Maumee River, the Ohio EPA Northwest District Office reports that Jennison-Wright (J-W) has entered into a consent decree with OEPA on February 4, 1987. Pursuant to the terms of this agreement J-W has prepared a Remedial Investigation Work Plan (utilizing Woodward Clyde Consultants). This work plan was approved, with conditions by OEPA on January 27, 1988. The RI is designed to provide a data-base for determining the best remediation alternative and extent of contamination.

Storm, sanitary, and treated process waters flow from the 26 acre site, located at 2332 Broadway, into the municipal sewer system. A 12" overflow from the city sewer flows through the J-W property into the Maumee River. The office parking lot, at 3463 Broadway, borders the Maumee's west bank. Contamination and remediation alternatives will be addressed by the RI/FS for this also.

RCRA Facilities

Hazardous waste regulations are implemented by Ohio EPA's Division of Solid and Hazardous Waste Management, and cover generation, storage, transportation, and treatment or disposal of hazardous wastes as defined in RCRA and the 1984 Hazardous and Solid Waste Amendments. Ohio's hazardous waste regulations were passed in 1980. Permits to operate hazardous waste facilities are issued by the Ohio Hazardous Waste Facility Board with monitoring and enforcement of the regulations being carried out by Ohio EPA.

Within the area of concern there are 13 different RCRA facilities licensed to operate as shown in Table 46. However, the Evergreen Landfill, operated by Ohio Waste Systems, a subsidiary of Waste Management, did operate as a hazardous waste facility until November 1985. The Fondessy Landfarm (Fondessy Enterprises Site #2) has not received refinery sludges for well over one year, with Ohio EPA recommending that the site be closed due to seasonal high water table and other problems.

TABLE 46

LIST OF RCRA FACILITIES

OHD #	Name	Address	
OHD045245271	Cast America Products	4243 South Ave.	43615
OHD005041843	E.I. DuPont deNemours	1930 Tremainsville	43613
OHD045243706	Fondessy*	876 Otter Creek Rd.	43616
OHD000721415	Fondessy* Landfarm Site #2	Cedar Point & Wynn	43616
OHD980279376	Texileather	3729 Twining St.	43608
OHD005562020	Owens-Illinois Tech. Center	1700 N. Westwood	43607
OHD980586804	XXKem	3903 Stickney Ave.	43608
OHD018354894	Sheller-Globe Corp.	Lint & Dura Aves.	43612
OHD063717565	Sheller-Globe Corp.	4444 N. Detroit Ave.	43612
OHD005057542	British Petroleum (BP)	Cedar Point Road	43614
OHD043642958	Luckey Beryllium	212 Luckey Road	43443

* = Now Envirosafe

Status of Superfund Sites

There are no designated Superfund sites in the AOC at this time (i.e., no sites have been included in the National Priority List under Superfund/CERCLA). All the preliminary assessments have been conducted for the sites listed in the following table. This is the first step in potential Superfund listing. Those sites listed in the Table 47 have the possibility of being named hazardous waste sites. All the sites listed are considered unregulated sites and each has been ranked high (H), medium (M), Low (L), or no priority (0).

The Ohio EPA Northwest District Office reports that Allied Automotive Toledo Stamping, Owens-Illinois (Hilfinger), Phillips Petroleum, and Webstrand sites have undertaken clean-up efforts. In cases where responsible companies can be identified, the EPA will try to get funding for cleanup from the businesses involved. The list of possible hazardous waste sites was compiled because of the federal Superfund Law, which required each company to report its hazardous waste activities of the past. The list not only includes these sites, but also sites reported by residents and anonymous tips.

Table 47 includes the U.S. EPA assigned number, the site name and address where known, the U.S. EPA Federal Investigation Team (FIT) ranking, and the Ohio EPA priority ranking. The actual list of potential problem sites is known as CERCLIS.

TABLE 47

POSSIBLE HAZARDOUS WASTE SITES

OHD #	Name and Address		FIT	Ohio EPA
OHD980678379 348-0024	Allen Charles Waste Removal Address Unreported (Transporter) Toledo	 99999	L	L
Not Assigned 348-1027 Not on CERCLIS	Allied Automotive Toledo Stamping Fearing Blvd. Toledo	 99999	--	--
OHD980823801 348-0045	Anderson's 439 Illinois Avenue Maumee	 43537	M	L
Not Assigned 348-1029 Not on CERCLIS	Champion Spark Plug 900 Upton Avenue Toledo	 43607	--	--
OHD980611636 348-0175	City Owned Dump (AMC, North Cove) Foot of Drexel Dr. I-75 & Cove Toledo	 43610	--	H
OHD000816843 348-0197	Commercial Oil Service, Inc. 3600 Cedar Point Road Oregon	 43616	--	--
OHD980826119 348-0200	Consul Street Landfill 2510 Consul Street Toledo	 43624	O	L
OHD043636463 348-0207	Coulton Chemical 6600 Sylvania Road Sylvania	 43560	--	--
OHD020260188 348-0208	Coulton Chemical Corp. 1400 Otter Cheek Road Oregon	 43616	L	L
OHD068081595 348-0211	Cousins Waste Management 2611 W. Center Toledo	 43609	L	L

(continued)

TABLE 47
(continued)
POSSIBLE HAZARDOUS WASTE SUPERFUND SITES

OHD #	Name and Address		FIT	Ohio EPA
OHD986967800 348-1158	Dial Corporation 6120 N. Detroit Ave. Toledo	43612	--	--
OHD990777930 348-0248	DuPont E.I. deNemours & Co., Inc. Matzinger Rd., P.O. Box 6568 Toledo	43612	L	M
Not Assigned 348-1031 Not on CERCLIS	Erie Coatings 600 S. Hawley Toledo	99999	--	--
OHD980613640 348-0286	Essex Group, Inc. 5101 Telegraph Road Toledo	43612	O	O
OHD045243706 348-0303	Fondessy 876 Otter Creek Road Oregon	43616	L	H
Not Assigned 348-1148 Not on CERCLIS	Front St--Millard Ave. Millard Avenue Toledo/Oregon	99999	--	--
Not Assigned 348-1034 Not on CERCLIS	Greise Brothers 600-1 Bassett Street Toledo	99999	--	--
OHD005052410 348-0365	Gulf Oil Co., Toledo Refinery 2935 Front Street Toledo	43697	M	M
OHD000608695 348-0367	Gulf Oil Toledo Terminal 2774 Front Street Toledo	43605	--	--
Not Assigned 348-1032 Not on CERCLIS	Harrison Junkyard 10259 Dorr St. Spencer Twp.	99999	--	--
OHD981097157 348-0385	Heist Cleaning Service 3804 Cedar Point Road Oregon	43616	L	M

(continued)

TABLE 47
(continued)
POSSIBLE HAZARDOUS WASTE SUPERFUND SITES

OHD #	Name and Address		FIT	Ohio EPA
OHD000605295 348-0441	King Road Lucas County San. 3535 King Road Toledo	43617	M	M
OHD000817114 348-1166	Koppers 2563 Front Street Toledo	43605	--	--
OHD005050349 348-0463	Libbey-Owens-Ford Co., Plants 4 & 8 1769 E. Broadway Toledo	43605	--	--
OHD981529092 348-0482	Manhattan Dump 2020 Manhattan Blvd. Toledo	43612	L	L
OHD980615801 348-0502	Maston Septic Service 7202 Providence Whitehouse	43571	O	L
OHD980704381 348-0503	Matlack Trucking Co. 1728 Drouillard Road Toledo	44309	L	L
OHD005045992 348-0568	NL Industries 5400 N. Detroit Avenue Toledo	43612	L	L
OHD005051180 348-0569	NL Industries, Inc. Bearings Div. 715 Spencer Street Toledo	43609	L	L
OHD000720268 348-0576	North American Car Corp. 4545 Hoffman Road Toledo	43611	O	L
OHD980679427 348-0588	Oberly Ray DSPL 3812 Twining Street Toledo	43608	O	L
OHD9806159344 348-0589	Oberly Robert Waste Removal 3903 Stickney Toledo	43608	L	L

(continued)

TABLE 47
(continued)
POSSIBLE HAZARDOUS WASTE SUPERFUND SITES

OHD #	Name and Address		FIT	Ohio EPA
OHD980991798 348-0616	Owens Illinois Hilfinger 1800 N. Westwood Avenue Toledo	43606	M	M
OHD005034459 348-0621	Owens-Illinois Libbey Plant 27 940 Ash Street Toledo	43611	L	L
OHD005562020 348-0622	Owens-Illinois Tech. Center 1700 N. Westwood Avenue Toledo	43607	L	L
OHD980901276 348-0633	Phillips Petroleum Property Front St. & Millard Ave. Toledo	43605	L	L
OHD018354894 348-0730	Sheller-Globe Corp. Cy Auto Stamping Div. Lint & Dura Avenue Toledo	43612	L	M
OHD005057542 348-0767	Standard Oil Co. (Ohio) Lallendorf & Cedar Point Road Oregon	43616	O	L
OHD005046511 348-0781	Sun Oil Co. Of Pennsylvania 1819 Woodville Road Oregon	43616	L	L
OHD980679419 348-0787	Swan Creek Landfill Glendale Avenue Toledo	43614	L	L
OHD000605956 348-0812	Toledo City of Stickney Ave. Dspl. Site 3900 Stickney Avenue Toledo	43612	M	H
OHD980611685 348-0813	Toledo Edison Co. Coke Oven Gas Line Front & Cherry Streets Toledo	43652	L	L
OHD980509905 348-0814	Toledo Ldfl. City of Aka Dura San Ldfl Dura Ave. Toledo	43612	L	M

(continued)

TABLE 47
(continued)
POSSIBLE HAZARDOUS WASTE SUPERFUND SITES

OHD #	Name and Address		FIT	Ohio EPA
OHD980611677 348-0815	Toledo Powdered Metal Cross Street Toledo	 43623	L	L
OHD980510499 348-0816	Toledo Sewage Disposal Plant Bay View Park Toledo	 43611	L	L
OHD980611305 348-0818	Treasure Island Landfill Counter & Kalamazoo & York Sts. Toledo	 43611	M	M
OHD980510523 348-0829	Tyler Street Dump Tyler St. Toledo	 43612	Y	M
OHD005055777 348-0839	Union Oil Co., Toledo Refinery 1840 Otter Creek Road Oregon	 43616	L	L
OHD980510580 348-0918	W/S Ave. Toledo Mun San Landfill South Ave & Maumee River Toledo	 43615	L	M
OHD981525710 348-0895	Webstrand Corp. 525 Hamilton Street Toledo	 43602	L	L
OHD000606368 348-0901	Westover Corp. San Landfill 820-920 Otter Creek Road Oregon	 43616	M	M

(continued)

TABLE 47
(continued)
POSSIBLE HAZARDOUS WASTE SUPERFUND SITES

OHD #	Name and Address		FIT	Ohio EPA
OHD005044128 387-0033	American Cyanamid Co. 12600 Eckel Road Perrysburg	 43551	O	O
OHD980610935 387-0071	Asman's Landfill Rt. 795 & Fostoria Road Millbury	 43447	M	M
OHD041350323 387-0167	Chrysler Corp. Toledo Machining Plant 8000 Chrysler Drive Perrysburg	 43551	L	L
OHD087050019 387-0190	Coastal Tank Lines 6622 SR-795 Walbridge	 43465	L	L
OHD068111327 387-0294	Evergreen Landfill 6525 Wales Road Northwood	 43619	L	M
OHD981529084 387-0454	Lake Township Dump Hanley Road & Cummings Road Walbridge	 43465	L	L
OHD005050406 387-0462	Libbey-Owens-Ford Co. Plant 6 140 Dixie Hwy. Rossford	 43460	L	L

Some of the sites on Table 47 are also on Tables 44 and 45. All of the sites are not separate and may have different names due to "aliases."

Underground Storage Tanks

The federal definition of an Underground Storage Tank (U.S.T.) is any tank including underground piping connected to the tank that has at least 10 percent of its volume underground. Not included in this definition are the tens of thousands of unregulated domestic heating oil tanks or other private fuel tanks. Several types of underground tanks are currently exempt from federal regulation:

farm and residential tanks holding less than 1,100 gallons of motor fuel used for non-commercial purposes;

tanks storing heating oil burned on the premises where it is stored;

tanks on or above the floor of underground areas, such as basements or tunnels;

septic tanks and systems for collecting storm water and waste water;

and flow-through process tanks.

Hazardous waste tanks are regulated under Subtitle C of the Resource Conservation and Recovery Act (RCRA). Waste oil tanks may eventually also be regulated under Subtitle C. The great majority of U.S.T.s nationwide (more than 96 percent) contain petroleum fuels; the remainder store raw chemicals. U.S.T.s are found virtually everywhere in the industrialized world. U.S. EPA estimates that approximately one quarter of the U.S.T.'s leak (OEC, 1988).

In Ohio more that 70,000 commercial U.S.T.s currently in use are registered with the State Fire Marshal. Because the registry is still being developed, the Fire Marshal's Bureau of Underground Storage Tank Regulation estimates that there are actually close to 100,000 U.S.T.s in Ohio subject to regulation. As of May 1988, the registry was still incomplete. There are 2,834 U.S.T.s for Lucas County, 879 for Wood County, and 284 for Ottawa County. Because U.S.T.s are associated with business and industry, it appears that they are found in higher concentrations in areas of greater population (OEC, 1988).

Statewide, there have been more than 1,800 leaks from U.S.T.s reported to Ohio EPA since 1978. Ohio EPA's Office of Emergency Response reports that during this period there have been 50 reported leaks for Lucas County, 22 for Wood County, and 12 for Ottawa County. The majority (65 to 75 percent) of U.S.T. leaks came from tanks at gas stations.

Leaks in USTs typically are very small compared to tank size, and traditional inventory control measures such as the graduated dipstick pole and tallying volumes of liquid withdrawn are not accurate enough to detect most leaks. U.S.T.s have contaminated ground water and surface water, saturated soil with gasoline or other flammable or toxic substances, and created fire and explosion hazards when vapors enter buildings through foundation cracks or sump pumps. Gasoline from U.S.T.s in developed areas frequently is first discovered in utility company manholes, where it can destroy wiring and cause an explosion due to the concentration of gasoline vapors and a health hazard for workers due to the concentration of residual benzene in a confined space (OEC, 1988).

ATMOSPHERIC DEPOSITION

According to the 1987 Report on Great Lakes Water Quality (IJC, 1987), atmospheric transport and deposition into the Great Lakes basin, either directly onto the water surface or indirectly into the drainage basin with subsequent transport, has been clearly demonstrated. This summary report states that even though the magnitude of the input (relative to other sources and pathways) has not been fully defined, the available evidence indicates that atmospheric deposition is a major pathway for contamination of the Great Lakes ecosystem.

Releases of lead to the atmosphere, primarily from automotive exhausts, have decreased as the use of leaded gasoline in the United States and Canada has decreased, and that atmospheric transport and deposition of certain pesticides (e.g. DDT) into the Great Lakes continues today, even though their use has been banned or severely restricted in both the United States and Canada. These chemicals are still manufactured and used in great quantities in other locations in the world. Short of a worldwide ban on the manufacture, transport and use of these contaminants, appreciable contamination of the Great Lakes ecosystem may continue indefinitely.

The authority to regulate emissions into the atmosphere are based on clean air requirements, but legislative provision to control emissions of persistent toxic substances into the atmosphere need to be incorporated. The Ohio Alliance for the Environment in its March 1987 Newsletter reports that since 1987 improvements have been made in reducing the amount of discharge from direct sources of toxic contaminants, but much more research and action is still needed to restore the lakes to a healthy level; and that little is known about the specific effects and possible controls for toxic chemicals into the air.

The Ohio Alliance for the Environment's report goes on to say, that seven million chemical compounds now exist, 30,000 of which are in substantial commercial use; that approximately 1,000 new chemicals are developed each year; that over 1,000 chemicals are suspected carcinogens. It is important to note that some of these chemicals occur naturally, which means that manufactured chemicals are not the only source of toxic substances.

Air emissions of such substances are a concern because the atmosphere serves as a pathway into the environment as a whole. Large lakes such as the Great Lakes, tend to act as a "sink" for pollution from all sources. It has been shown that with the upper Great Lakes, the input of toxic chemicals such as PCBs and lead comes from atmospheric deposition.

The current USEPA and Ohio EPA ambient air quality standards are displayed in Table 48 on the following page. The Toledo Environmental Services Division functions as the air pollution enforcement arm of the Ohio EPA in the Toledo area. This Division was interviewed in order to secure information regarding attainment/non-attainment status regarding the pollutants listed in this table, with such status reported as on Table 48.

TABLE 48

US EPA & OHIO EPA AMBIENT AIR QUALITY STANDARDS*

POLLUTANT	DURATION	RESTRICTION	MAXIMUM ALLOWABLE CONCENTRATION** PRIMARY	SECONDARY
Particulate Matter - PM10	Annual geometric mean	Not to be exceeded	50 mg/m^3	50 mg/m^3
	24 - hour concentration	Not to be exceeded more than once per year	150 mg/m^3	150 mg/m^3
Sulfur Dioxide	Annual arithmetic mean	Not to be exceeded	80 um/m^3 (0.03 ppm)	——
	24-hour arithmetic mean concentration	Not to be exceeded more than once per year	365 um/m^3 (0.14 ppm)	——
	3-hour arithmetic mean concentration	Not to be exceeded more than once per year	——	1300 um/m^3 (0.5 ppm)
Carbon Monoxide	8-hour arithmetic mean concentration	Not to be exceeded more than once per year	10 mg/m^3 (9.0 ppm)	——
	1-hour mean concentration	Not to be exceeded more than once per year	40 mg/m^3 (35.0 ppm)	——
Ozone	1-hour mean concentration	Not to be exceeded on more than one day per year, average over three years	0.12 ppm (244 um/m^3	——
Nitrogen Dioxide	Annual arithmetic mean	Not to be exceeded	0.53 ppm (100 um/m^3	——
Lead	3-month arithmetic mean concentration	Not to be exceeded	1.5 m/m^3	——

NOTES:

Primary standards are established for the protection of public health
Second standards are established for the protection of public welfare

um/m^3 = micrograms per cubic meter
ppm = parts per million
mg/m^3 = milligrams per cubic meter

* = U.S. EPA & Ohio EPA Air Quality Standards are Identical
** = 40CFR 50.4 - 50.12

LEAD: Attainment

Lead is a toxic metal released into the atmosphere primarily through the exhaust of automobiles using leaded fuels. Lead accumulates in the human body and can interfere with the blood-forming process, and the normal nervous and renal system functions. Young children are most susceptible to the ill effects of lead. The level of this pollutant has dropped substantially since the early 1970s. Because of enforcement activities related to fuel switching and the further reduction of lead levels in leaded gasoline, the data from recent years shows that the air quality in the area of concern related to lead is approximately 10 times cleaner than the national standard.

NITROGEN DIOXIDE: Attainment

Nitrogen dioxide is a brown gas, formed during high temperature combustion, which reacts with hydrocarbons in the presence of sunlight to produce photo-chemical oxidants or smog. It is also a pollutant in its own right, and can affect lung tissue, reduce resistance to disease, contribute to bronchitis and pneumonia, and aggravate chronic lung disorders. It is also a contributor to acid rain. The level of this pollutant has dropped with no violation ever having been recorded in the area of concern. In fact, routine monitoring of this pollutant was ended in July 1981, but reestablished in 1984 through a scaled-down sampling system in order to keep abreast of any new trend.

OZONE: Non-attainment

Ozone is a colorless, pungent, toxic gas, formed by a series of chemical reactions where hydrocarbons, nitrogen oxides from automobiles and other sources, are exposed to sunlight. Ozone is the principal constituent of smog, and is a severe irritant, impairing lung function and aggravating existing respiratory disorders. The level of this pollutant has dropped with only one violation of the standard in 1983, and no violations for succeeding years. Significant reduction in hydrocarbon emissions have taken place in recent years with redesignation expected by U.S. EPA to attainment status.

CARBON MONOXIDE: Attainment

Carbon monoxide is a colorless, odorless, tasteless, toxic gas produced by incomplete combustion of fossil fuels. The automobile engine is the main source of this pollutant. It is quickly absorbed by the blood, and reduces the oxygen available to the tissues, impairing visual perception and alertness. Continued exposure to elevated carbon monoxide levels can threaten life. Persons with cardiovascular diseases are especially vulnerable to this type of pollution. The level of this pollutant dropped measurable in 1976 and 1983. Two violations were measured in 1984, but none in the intervening years.

SULFUR DIOXIDE: Non-attainment for area east of Route 23 and west of eastern boundary for City of Oregon attainment for remainder area.

Sulfur dioxide is a heavy, pungent, colorless gas formed primarily by the combustion of sulfur-bearing fuels such as coal. It reacts readily with other atmospheric compounds and pollutants to form sulfates, a group of compounds that aggravate respiratory ailments such as bronchitis, emphysema, asthma and heart disease. Sulfates, combined with moisture in the atmosphere, produce acid rain. The area of concern is classified as non-attainment for sulfur dioxide, but there have been no violations, either primary or secondary, of the U.S. EPA Standards since 1979.

PARTICULATE MATTER: Attainment for primary sources, but non-attainment secondary sources for areas of East Toledo and Oregon, with attainment for secondary sources in the remainder area.

Particulate matter relates to particles in the air (such as soot, ash, etc.), including non-toxic materials (dust and dirt), as well as toxic substances (lead, asbestos and sulfates). Natural and man-made sources can contribute to adversely affect human respiratory systems to various degrees, depending on particle size and composition. Data show no violation of either primary or secondary standards for 1983, 1984 or 1985 with the Toledo Environmental Service Division petitioning for redesignation to total primary and secondary attainment for the entire area. However, there is a small area, mainly in East Toledo, where the monitoring station is located, that indicated a secondary violation for 1986.

<u>Acid Rain</u>

The Great Lakes National Program Office, U.S. EPA, has operated the Great Lakes Atmospheric Deposition (GLAD) network since early 1981. A precipitation sampling station as a part of GLAD had been located by Toledo Environmental Services Division in Oregon, Ohio at Bay Shore and Stadium Roads, from 1981 through 1985. Due to budget constraints this local sampling station was thereafter eliminated, with the nearest stations being Put-in-Bay, Ohio on South Bass Island, and Mount Clemons, Michigan.

During the period when local precipitation sampling station was in operation, the process consisted of collecting weekly samples and checking for pH and conductivity before sending the sample to the GLAD laboratory for further analysis. The pH of unpolluted rain is about 5.6. Because the pH scale is logarithmic, rain with a pH of 4.6 is ten times as acidic as "normal" rain, while rain with a pH of 3.6 would be 100 times as acidic. Figure 21 graphically displays the quarterly pH averages for the period covering 1981 through 1985 (Environmental Service Agency, 1985). The quarterly averages indicate that rainfall in the Toledo area is often 50 to 100 times more acidic than normal rainfall. The GLAD laboratory analysis for chemical pollutants was available for only one year, therefore, weighted calculations were not conducted.

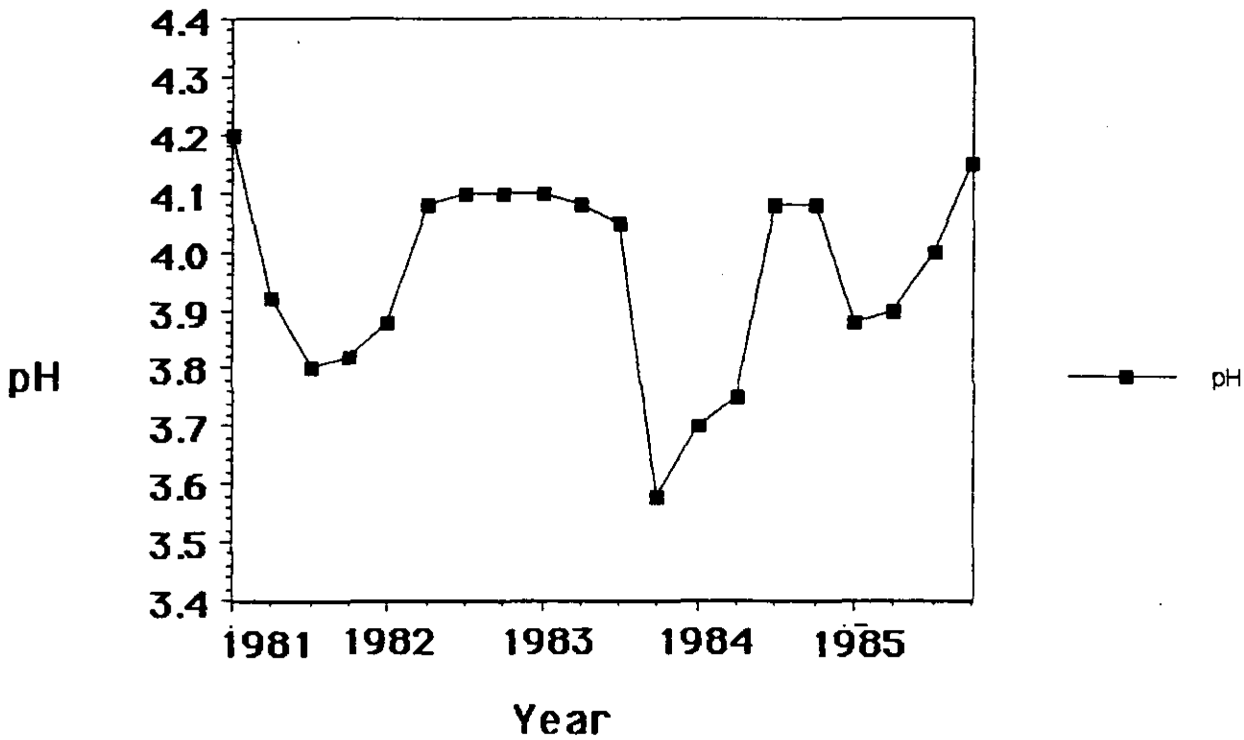
The area of concern is most fortunate in that the acidic rainfall seems to be buffered by our natural occurring limestone bedrock and local soils which mitigate the ecological effects of acid rain. However, even though most of the ecological effects to the local area are mitigated, there is substantial damage being caused locally by acid rain. Buildings and statues are being corroded, cars rust more quickly and their paints are damaged, and synthetic materials ranging from clothes and nylons to windshield wipers become more rapidly unusable. In addition, heavy metals are leached more readily from structures and soils, so the acid rain may be contributing to the presence of toxic substances in the water. Reduced productivity of farm crops, particularly soybeans, and forest resources has also been linked to acid rain. The buildings, statues, cars, trees and agricultural products all are impacted by the precipitation before it can be neutralized by the soil and bedrock of the area.

Wildlife resources locally may also be experiencing degradation due to the acidity. Many animal resources rely in early spring on temporary ponds and marshes for their breeding areas and important food resources. Most affected are the amphibians and waterfowl that move into these ponds and wetlands even before the snow has melted. Since the ground is still frozen, its ability to neutralize the acidity may be greatly limited. The most acidic precipitation of the year often occurs as snow in fall and winter. The spring snow melt may be sending a rush of still acidic water to the ponds and marshes at a critical time. For instance, most salamander species move into the breeding ponds for a brief period, beginning before the ice melts off of the pond. Salamander mortality has been directly linked to the acidity of their breeding ponds.

The decline of black duck populations is also now believed to be linked at least in part to the acidity of their feeding ponds when they arrive in early spring. Other migratory waterfowl are also finding reduced abundance of aquatic insects because the spring flush of acidic waters reduces insect populations at a time when food needs are high in order to fuel migration and prepare for the breeding season.

Despite the acidity of rain water in the RAP Area, water in streams is generally alkaline, as shown by Table 49. The pH averages 7.7 to 7.8 for all streams, with the exception of Otter Creek, which is notably more alkaline than any other stream in the area.

Figure 21
PRECIPITATION pH vs. TIME



Source: Environmental Services Agency, 1985.

TABLE 49

pH VALUES IN RAP AREA STREAMS
TESD DATA, 1981-1986

Stream Sampled	pH <6.0	6.0-6.9	7.0-7.9	8.0-8.9	9.0-9.9	>10.0	Avg	# Samples
All streams	1	79	809	486	28	1	7.8	1404
Maumee River Subwatershed								
Maumee River	0	23	196	165	3	0	7.8	387
Delaware Cr.	1	5	33	16	0	0	7.6	55
Grassy Cr.	0	6	30	20	0	0	7.7	56
Otter Cr.	0	0	7	28	21	0	8.7	56
Shantee Cr.	0	2	33	19	0	0	7.8	54
Silver Cr.	0	3	32	19	0	0	7.7	54
Ottawa River Subwatershed								
Ottawa River	0	27	255	134	4	1	7.7	421
Hill Dt.	0	3	36	16	0	0	7.7	55
Swan Creek Subwatershed								
Swan Creek	0	9	153	54	0	0	7.7	216
Heilman Dt.	0	1	34	15	0	0	7.7	50

TESD Air Sampling

TESD has eleven air sampling network sites. These are described in Table 50 by station number, location, and type of testing performed. The table also includes map numbers which correlate with Figure 22, a map that displays the location of air sampling sites.

TABLE 50

TESD AIR SAMPLING NETWORK SITES

Map #	TESD STATION	LOCATION	TESTS PERFORMED
6	1	East Side Sewage Pumping Station Lee and Front St.	T.S.P.
7	2	East Side Central School 825 Navarre Ave. at Berry St.	T.S.P
8	3	Oregon Municipal Building 5330 Seaman	T.S.P.
9	4	Rossford Municipal Building 133 Osborn Street	T.S.P.
10	5	60 N. Westwood at Hill (soon moving to U.T. Comm. Tech. and converted to P.M. 10)	T.S.P
11	6	1503 Broadway at South	T.S.P.
2	7	2927 Monroe (at Bancroft & Detroit) (heavy traffic intersection)	CO
3	8	2930 - 131st. Street	O_3
4	9	Water Filtration Plant 600 Collins Park	SO_2
5	10	Acid Rain Monitoring Site	Acid Rain
1	11	Toledo Environmental Services Bldg.	T.S.P., SO_2

T.S.P. = Total Suspended Particulates
CO = Carbon Monoxide
SO_2 = Sulfur Dioxide
O_3 = Ozone
NO_2 = Nitrogen Dioxide

<u>Acid Rain</u>
PM-10 Particulate Matter - 10 microns (a more refined T.S.P. Test; other T.S.P Sites may be converted at a later date)

Source: Rick Uscilowski - Chief Chemist, Toledo Environmental Services Div. (TESD)

WATER QUALITY IMPACTS

The previous sections of this report focused on the identification and discussion of the water quality problems present in the Lower Maumee River Area of Concern. These data were used to classify each of the subwatersheds in the AOC as to severity of the water quality problem caused by each of the identified water quality sources. In order to accomplish this, a rating system ranging from high impact to suspected low impact and the criteria to assign the ratings was developed by the Remedial Action Plan Advisory Committee and associated subcommittees. The subcommittees applied the rating system to each subwatershed for each of the identified water quality problems in order to assess the geographical extent of the water quality problems. The results of this analysis, a series of plots with graduated shading to indicate the degree of impact, are presented in Figures 23 through 35. The individual subwatershed analyses are presented in Appendix J. The criteria used to evaluate the severity of the water quality impacts due to each of the sources of pollution follow.

Rating System

The rating system used classifies the effects of each of the identified water quality problems as:

H	High impact
M	Medium impact
L	Low impact
N	Not applicable to this watershed/None
U	Unknown
US	Unknown, but suspected problem
S	Suspected problem, but no data
HS	Suspected high impact
MS	Suspected medium impact
LS	Suspected low impact

POTWs (See Figure 23)

The severity ratings which were assigned take into account the quality of the plant effluent and the quantity of effluent relative to the size of the receiving stream. The Whitehouse POTW is not included because it has been abandoned in favor of connecting to the Lucas County system.

The rationale used in assigning these impact ratings is as follows:

In most watersheds, there are no POTW discharges, so the rating is "N".

- The Toledo Bay View plant is a large facility with a significant number of NPDES discharge permit violations. Its impact is rated "H".

- The Oregon South Shore Park and DuPont Road treatment plants discharge to the lake. The DuPont Road plant is under capacity, and has a relatively small number of permit violations; its rating is "M". The South Shore Park plant, however, has severe problems from extraneous water entering the sewers. This plant has many permit violations and its rating is "H". Together their impact is rated "H".

- The Maumee River WWTP has few permit violations and discharges to a sizable stream (the river). Its impact rating is "L".

- The Perrysburg plant is not a large facility, but it has serious problems and more permit violations than any other POTW. Its impact is rated "H".

- The Haskins plant has a small number of permit violations but it discharges to a roadside ditch. However, its effect on the Maumee River itself is low. For this reason, its impact is rate "L".

<u>Package Plants</u> (See Figure 24)

In most cases, the only information regarding package plants is their location and size. A listing of NPDES Permit Violations (Appendix I), however, indicates that even package plants run by trained operators do not discharge very high quality effluent. Furthermore, even well-run package plants are vulnerable to upsets and can turn septic in a matter of hours. For this reason, package plants' impacts are rated either "N" for None, or "H" for High.

<u>Industrial</u> (See Figure 25)

The listing of NPDES Permit Violations in many cases agrees with the list of "Problem Dischargers". The classification of what is industrial and non-industrial is based on Ohio EPA's system. If the NPDES Permit number starts with "I", it is industrial. If it starts with "2P", it is not. By this classification, 186 of the 627 NPDES violations, or 30%, were from industrial dischargers.

Of the 186 industrial permit violations listed, 76 of them are from three "Problem" dischargers (Sun Oil 2IG00003, General Mills 2IH00093, and King Road Landfill 2IN00079), for an average of 25 violations. The other five "Problem" dischargers do not show any permit violations at all (Conrail 2IT00015, Conrail 2IT00007, Doehler-Jarvis 2IC00021, LOF 2IN00030, and LOF 2IN00020).

Fourteen non-problem dischargers account for the remaining 110 violations for an average of 8 apiece. Of these, the Toledo Edison ACME plant (2IB000001) shows 26 violations (mostly suspended solids); DuPont Paint (2IF00016) had 9 (all temperature); Diversitech (2IQ00012) had 9 (mostly oil & grease); Chessie system (CSX Presque Isle, 2IT00013) had 10 (oil & grease, pH, SS); and the Bowling Green water plant (2IW00010) had 19 (all SS). Based on this information, Diversitech was added to the list of "Problem" dischargers.

The following criteria were used for defining L/M/H impact for Industrial Dischargers:

- Watersheds which have no industrial dischargers are rated "N".

- Watersheds that have one or more "Problem" industrial dischargers are rate "H".

- A discharger that has more than 8 violations (the average number for "Non-Problem" dischargers) is rated "M".

- A discharger with 8 or fewer violations is rated "L".

- Where a watershed has more than one industrial discharger, the most severe impact rating applies.All other industrial NPDES dischargers reported no permit violations in this period and are rated as having a low (L) impact on their watersheds.

It may be noted that five of the "Problem" dischargers reported no permit violations. The Public and Industrial Wastewater Subcommittee offers the following notes to account for this:

Conrail, Emerald Avenue (2IT00015)

No explanation for why this discharger does not show violations in its Monthly Operating Reports (MORs). The receiving stream is severely impacted by oil discharge from this facility.

Conrail, Stanley Yard (2IT00007)

The problem at this site is more old spills than present discharges. A spill would not necessarily show up on the MORs, which is why this discharger does not show any violations.

Doehler-Jarvis (2IC00021

The suspected problem from this discharger is a periodic spill of soluble oils. Being intermittent, it would not necessarily show up on the MORs submitted to Ohio EPA. Periodic discharges to the stream have been documented, and while Doehler-Jarvis is the suspected source, the discharge has been traced back to this facility on only one occasion.

Libbey-Owens-Ford, Plants #4 & 8, East Broadway (2IN00020)

Otter Creek used to flow under the landfill at this site, and leaching into the creek was a problem. Otter Creek has now been diverted to flow around the landfill instead. At present, there is still some discharge. The leachate will be collected and pumped to the City of Toledo's sanitary sewer system.

LOF, Plant #6, Rossford (2IN00030)

The main pollutant cited from this discharger was arsenic. No violations were reported, however, because arsenic was not included in the permit (2IN00030*ED).

LOF has installed a leachate collection system here and eliminated the arsenic discharge. The leachate now goes to a treatment lagoon.

LOF has made substantial progress toward cleaning up both its facilities in Rossford/East Toledo. It is anticipated that the improvements made will solve the problem and remove LOF from the "Problem" discharger list. At present, however, new data are not yet available to document this.

CSOs (See Figure 26)

Watersheds which receive no discharges from CSOs are all rated "N". TESD data for 1981-1986 indicate the following tallies of fecal coliform counts in excess of 2000/100ml:

Stream	Fecal Coliform Counts over 2000	Total Number of Samples	Percent Over 2000/100ml.
Maumee River	79	399	20%
Ottawa River	162	436	37%
Swan Creek	102	224	46%

These numbers show a more severe effect on Swan Creek and the Ottawa River than on the Maumee River. There are no POTWs discharging to the Ottawa River, and there are few package plants and septic systems in the reach of stream monitored. The most severe bacterial counts were found between mile points 3.1 (Suder Ave.) and 8.9 (Monroe St.) which is in the CSO area.

On Swan Creek, conditions are similar. There are many package plants discharging to Swan Creek, but mostly upstream of the TESD sampling sites. The Whitehouse WWTP also was discharging to a tributary of Swan Creek during this period, but again, far upstream of the TESD sites. The severe bacterial counts were found between mile points 0.6 (St. Clair) and 5 (Detroit Ave.) which is the CSO area.

The Maumee River watershed with CSOs show fecal coliform violations, but at a lower frequency. Also, the Maumee River CSO area receives effluent from the Toledo and Perrysburg WWTPs, both of which had fecal coliform effluent violations. In addition, water from Swan Creek joins the Maumee in this reach. The POTWs and the two tributaries are sources of fecal coliform besides the local CSOs.

Swan Creek and Ottawa River watersheds with CSOs are both rated "H". The effect of CSOs on Swan Creek due to the Whitehouse bypasses is rated "H". Two segments of Swan Creek are rated "M". Watershed 041 receives the impact of the Whitehouse CSOs at its upstream end, but the rest of the watershed has none. In 010 in Toledo, the upper end of the watershed is above the CSOs, but the lower end has several. Maumee River CSO watersheds are rated "M", not because CSOs are not a problem, but because their effect is less severe due to dilution.

<u>Urban Runoff</u> (See Figure 27)

No water quality monitoring has ever been performed to document the effects of urban runoff in the RAP area. Not having any better information, it is assumed that the water quality effects of urban runoff depend only on the degree of urbanization of the watershed.

The LRIS land use database was used to determine the percentage of urban land uses and the impact ranking for each subwatershed.

Since the land use data were collected in 1975, there have been some significant land use changes since then. The major growth areas have been in the following areas:

003	Sylvania & Sylvania Twp.
009	Springfield Twp.
041	Maumee & Monclova Twp.
042	Springfield & Swanton Twps.
046	Perrysburg & Perrysburg Twp.
079	Perrysburg & Perrysburg Twp.

These watersheds are rated "MS" for suspected medium impact from urban runoff. Exception: watershed 079 is rated "M" based on 1975 land use.

Agricultural Runoff (See Figure 28)

Determination of the level of agricultural runoff impacts was based on watershed rankings in the State of Ohio Phosphorus Reduction Strategy for Lake Erie and the the Ohio EPA's Ohio Nonpoint Source Assessment. Watersheds with a Priority 1 ranking in the Reduction Strategy or a nonpoint source impaired Assessment ranking were rated "H". Watersheds ranked nonpoint source impacted in the Assessment were rated "M". In those cases where watersheds were ranked differently in the two reports, the higher impact rating was used. The remaining watersheds were rated "L".

Dumps, Landfills, and Pits, Ponds and Lagoons (See Figure 29)

Watersheds which have no identified landfills, dumps, pits, ponds or lagoons are rated "N" (None).

Watersheds which have an identified landfill, dump, pit, pond or lagoon, but have no known discharge, are rated "M" (Medium).

Watersheds which have an identified landfill, dump, pit, pond or lagoon, and have a known discharge, are rated "H" (High).

Leaking Underground Storage Tanks (LUST) (See Figure 30)

The best data available for underground tanks at this time indicate the number known to exist in each county. There does not yet exist an inventory that gives their locations, ages and materials, nor whether the tanks are leaking. What the data do indicate is that there tend to be higher concentrations of underground tanks in urban areas than in rural areas. For this reason, the impact of underground tanks was rated using the same degree of urbanization criteria applied to urban runoff. Watersheds are rated "HS" for highly urbanized watersheds (over 50%), "MS" for moderately-urbanized watersheds (31%-50%), and otherwise "LS".

Dredge Disposal (See Figure 31)

The major effects of open lake disposal of dredged materials in the Area of Concern are limited to the Lake Erie and Maumee Bay since the current and proposed open lake disposal sites are located there. Therefore, Lake Erie and Maumee Bay were rated "H". Those segments of the Maumee River that make up the shipping channel were rated "M". All remaining watersheds were rated "N".

Home Sewage Disposal (See Figure 32)

Watersheds which are in urbanized areas with available sanitary sewers are rated "N" (None). The Home Sewage Disposal Subcommittee recognizes that some isolated home sewage systems do exist in sewered areas. These, however, are few enough not to have a significant impact on water quality on the watershed level.

Watersheds which have identified on-site systems but are not identified as problem areas by the county health departments are rated "M" (Medium).

Watersheds which have identified on-site systems and are identified as problem areas by the county health departments are rated "H" (High).

Atmospheric Deposition (See Figure 33)

While no specific information exists for the effects of atmospheric deposition of pollutants in the RAP area, there is documentation of this source causing water quality problems in Michigan and other parts of Ohio. Acid rain does not show any harmful effects to streams of the RAP area because of the buffering capacity of the native limestone. In fact, most streams tend to be alkaline (pH around 7.7). Air quality data give reason to suspect potential problems from deposition. All watersheds are rated "US" for Unknown but suspected problem".

WWTP Sludge (See Figure 34)

Water Treatment Plant sludge deposits are a problem in only a few specific watersheds, and these cases are well-documented. For all other watersheds, the rating is "L".

Contaminated Sediments (See Figure 35)

There are no specific standards for pollutant concentration in stream sediments. However, sediment guidelines have been established by Ohio EPA for the following metals: cadmium, arsenic, chromium, lead, copper, zinc and iron. U.S. EPA has established guidelines for the following parameters: Volatile Solids, Mercury, Cyanide, Nickel, Ammonia-N, Manganese, Total P, TKN and COD. Other toxic pollutants of concern include PAHs, PCBs and phthalates as these have been found above the detection limits.

Low (L) is applied wherein the Ohio EPA Guidelines Severity Ratings indicate Non-elevated Concentrations and U.S. EPA Guidelines Severity Ratings indicate Non-polluted.

Medium (M) is applied wherein the Ohio EPA Guidelines Severity Ratings indicate either Slightly Elevated or Elevated Concentration and the U.S. EPA Guidelines Severity Ratings indicate Moderately Polluted.

High (H) is applied wherein the Ohio EPA Guidelines Severity Ratings indicated either Highly Elevated Concentration or Extreme Elevated Concentration and U.S. EPA Guidelines Severity Ratings indicated Heavily Polluted.

Further, the U.S. EPA Guidelines Severity Ratings indicate Total PCBs of ≥ 10 mg/kg is heavily polluted. Criteria to be applied is High (H) to conform with this Guideline.

Dr. Paul Baumann, U.S. Fish & Wildlife, indicated that the concentrations for PAHs and phthalates were "...the lower end of the range of values for sites with cancer epizootics. However, I would consider these concentrations to pose a possible problem and to be of concern". Criteria to be applied could be High (H) for any concentration above the detection limit, but because there is no data supporting that it is in the Suspected classification.

GLOSSARY

305(b)	A biennial report from the state to U.S. EPA which describes the quality of the water of the state. Specifically, whether it meets the "fishable and swimmable" criteria mandated by the Clean Water Act. The term "305b" refers to the section of the Act requiring this report.
ug/l	Micrograms/liter (parts per billion)
Ag	Silver
As	Arsenic
BOD, BOD_5	Biochemical Oxygen Demand. This is a water quality parameter which serves as an indirect measure of the amount of organic matter (food) available for bacteria in a water sample. It measures the amount of oxygen, in pounds, needed to support the growth of bacteria in a water sample over a specified period of time; usually 5 days.
Ba	Barium, a "heavy metal".
Be	Beryllium, a "heavy metal".
BWQR	Biological Water Quality Report: a detailed water quality survey of a stream reach conducted by OEPA. BWQRs were formerly known as CWQRs (Comprehensive WQR).
Bypass	A point in a sanitary sewer system where untreated sewage can overflow directly to a stream instead of continuing to the treatment plant.
C	Carbon
CDF	Confined Disposal Facility. Diked areas in Maumee Bay which are used to hold and dewater sediments dredged off the bottom of the shipping channel.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, more commonly known as "Superfund," which provides authority for Federal cleanup of abandoned toxic waste sides and response to releases of hazardous substances into the environment.
CLEAR	Center for Lake Erie Area Research, a Lake Erie water quality monitoring program, sponsored by Ohio State University.
CN	Cyanide
COD	Chemical Oxygen Demand. An indirect measurement of the amount of carbon (food) in a water sample. This test is somewhat similar to the BOD test, in that it measures the pounds of oxygen needed to use up (oxidize) the carbon in a water sample. The COD uses chemicals to determine the amount of oxygen needed, while the BOD test is a biological test.
CSO	Combined sewer overflow.
$CaCO_3$	Calcium carbonate: "scale." Used as a standard in measuring water hardness.
Cd	Cadmium, a "heavy metal".
Cl,Cl^-	Chlorine, chloride. Chlorine is a poisonous gas commonly used to kill germs in treated sewage or drinking water. Chloride is an electrolyte, a "salt" (sodium chloride), and is not a disinfectant.
COE	US Army Corps of Engineers.
Combined sewage	Sanitary sewage and stormwater combined. Ideally, sanitary sewage and stormwater are carried in separate pipelines. In many inner-city areas, however, there is only one sewer system, and it carries combined sewage.

GLOSSARY
(continued)

Cond.	Conductivity: a specific laboratory test for determining the conductivity of a water sample. It indicates the quantity of dissolved electrolytes in a sample.
Cr	Chromium, a "heavy metal".
Cu	Copper
DO	Dissolved oxygen. Amount of oxygen dissolved in a water sample (in mg/l or ppm). DO is necessary for the survival of fish and other aquatic life.
EPA	Environmental Protection Agency. U.S. EPA is the Federal agency, and Ohio EPA is Ohio's statewide equivalent.
Eutrophication	A natural aging process generally describing the fertility (mainly aquatic plant productivity) of lakes. This process is speeded up if a lake receives an excess amount of nutrient pollutants, especially phosphorus.
F	Fluoride
Fe	Iron
Fecal Coliform	Bacteria which when found in large numbers in a water sample, indicate the presence of untreated sewage.
HUD	Housing and Urban Development. A Federal Agency which provides funding to assist cities and villages with housing and infrastructure problems.
GLISP	Great Lakes International Surveillance Plan.
Hg	Mercury, a "heavy metal"
I/I	Infiltration and Inflow: excess storm and/or ground water entering a sanitary sewer system.
ICI	Invertebrate Community Index: a numerical measure of water quality as reflected by a stream's ability to support aquatic life.
IJC	International Joint Commission
K	Potassium
kg	Kilogram(s): 1000 grams. A kilogram is slightly more than two pounds.
LEWMS	Lake Erie Wastewater Management Study.
LM	Lake mile. How many miles downstream (and out into Lake Erie) a given point is from the mouth of the Maumee.
Leachate	Liquid that leaks out of a landfill or dump; usually ground or surface water highly contaminated with wastes from the dump or landfill.
LWD	Low Water Datum.
MBAS	Methylene Blue Active Substance: a measure for the presence of surfactants in water or wastewater. Surfactants ("surface-active agents") are large organic molecules that cause water to foam or produce suds when agitated.
MG	Million gallons
mg	Milligram(s): a thousandth of a gram. There are 454 grams to a pound.
mg/kg	Milligrams per kilogram.
mg/l	Milligrams per liter (= ppm).
mgd	Million gallons per day
ml	Milliliter(s): a thousandth of a liter. A liter is slightly less than a quart.

MOE	(Ontario) Ministry of the Environment. Equivalent of EPA.
MP	Mile point. How many miles upstream (above) the mouth of a stream a given point is. See RM.
Methane	Natural gas. Formed by the decomposition of organic matter in the absence of oxygen.
Mn	Manganese
N	Nitrogen: one of the chemical elements which in certain forms is a nutrient necessary for life.
NH_3	Ammonia: a form of nitrogen, which is a pollutant.
NO_2	Nitrite(s): a form of nitrogen, which is a pollutant.
NO_3	Nitrate(s): a form of nitrogen, which is a pollutant.
ng/g	Nanograms/gram. "Nano" is a prefix which means "one billionth", or 10^{-9}. ng/g=ppb.
NPDES	National Pollutant Discharge Elimination System. Refers to a permit which is required in order to discharge wastewater to a stream. This permit dictates how clean the water must be before it can be discharged.
Na	Sodium
Ni	Nickel, a "heavy metal".
O/G	Oil and grease. In water quality monitoring, refers to a specific chemical test for amount of oils in a sample.
ODNR	Ohio Department of Natural Resources.
OEPA	Ohio Environmental Protection Agency.
P	Phosphorus. Considered the critical nutrient in the pollution of the Great Lakes. By limiting amount of phosphorus discharged to Lake Erie, the lake's eutrophication can be controlled.
PAH	Polynuclear Aromatic Hydrocarbons.
Pb	Lead, a "heavy metal".
PCB	Polychlorinated Biphenyls. Organic chemicals which, during the 50 years they were manufactured and used, an estimated 400 million pounds entered the environment, according to U.S. EPA Hazardous Waste laboratory. Their use ranged from dielectric oils to carbonless paper production. A colorless liquid, it was used as an insulating fluid in electrical equipment: e.g., transformers, capacitors, because of its stability and heat resistance. PCBs are a suspect carcinogen. A significant health impact has been linked to incomplete combustion of PCBs. The oxidation of PCBs form dioxins and furans, the most toxic of all man-made substances. They have been found in measurable concentrations in waterways and sediments throughout the world, and are widely-spread contaminants of fish and wildlife resources. PCB contamination began in an era when industrial wastes were disposed of by flushing them directly into waterways, local sewage treatment plants, or landfills.
PEMSO	Planning and Engineering Data Management System for Ohio (PEMSO) system, which Ohio EPA uses for classifying stream segments, modeling pollution sources, and their effects on water quality. Related watershed classification systems: TMACOG uses smaller watersheds, which are generally a subset of the PEMSO watersheds. The third system is Land Resources Information System (LRIS), developed for the 208 program, and further defined for the Lake Erie Wastewater Management Study (LEWMS). LRIS watersheds are usually, but not always, the same as TMACOG's.

pH	A measure of acidity or alkalinity, on a scale of 1 to 14. Neutral is 7.0; lower values are acidic, and higher values are alkaline (basic).
POTW	Publicly-Operated Treatment Works. A wastewater treatment facility operated by a city, village, or county that treats primary domestic sewage. Usually refers to a municipal sewage treatment plant.
ppb	Parts per billion (= ug/l).
ppm	Parts per million (= mg/l).
RCRA	Resource Conservation and Recovery Act of 1976.. Deals with the transport, storage, treatment, or disposal of hazardous wastes and their associated facilities.
RM	River mile: how many miles upstream (above) the mouth of a stream.
Regulator	A device used to control the bypass of untreated combined sewage to a stream. The purpose of the regulator is to allow the system to bypass combined sewage when the system is overloaded from stormwater; but to prevent bypasses during dry weather.
S.D.	Sewer District.
SO_4	Sulfate(s)
SS	Suspended solids: in water quality sampling, the weight of solids (in mg) suspended in a milliliter (ml) of water.
Se	Selenium
Superfund	See CERCLA
TDS	Total dissolved solids.
TESD	Toledo Environmental Services Division: a division of the City of Toledo which is responsible for performing air and water quality monitoring in Toledo. Formerly TESA (Agency).
TKN	Total Kjeldahl Nitrogen: a specific chemical test used to determine how much of certain forms of nitrogen are in a water sample. It includes organic and ammonia nitrogen, but excludes nitrites and nitrates.
TMACOG	Toledo Metropolitan Area Council of Governments: regional planning agency for Lucas, Wood, Ottawa, Sandusky and Erie Counties in Northwest Ohio, and Erie, Bedford, and Whiteford Townships in Monroe County, Michigan.
tpy	Tons per year.
Turb.	Turbidity: a measure of whether or not water is clear. When used in terms of water quality monitoring, it refers to a specific test used to quantity how turbid a water sample is.
USGS	United States Geological Survey. Federal agency involved in detailed mapping of the U.S., and surface and ground water monitoring.
WQ	Water quality.
WTP	Water Treatment Plant. Usually refers to a municipal plant for producing city drinking water.
WWH	Warmwater Habitat: a stream classification used by Ohio EPA to set the water quality standards for a stream. Warmwater standards are not as stringent as Coldwater.
WWTP	Wastewater Treatment Plant. Usually refers to a municipal treatment facility, and often used interchangeably with "Sewage Treatment Plant".
Zn	Zinc, a "heavy metal".

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